REVIEW of EDUCATIONAL RESEARCH

4788

Volume V FEBRUARY, 1935 Number 1

SPECIAL METHODS AND PSYCHOLOGY OF THE ELEMENTARY-SCHOOL SUBJECTS

This issue revises and brings down to date the issues of the Review of Educational Research for October 1931, entitled *Methods in the Elementary School,* and for December 1931, entitled *Psychology of the School Subjects.* Related issues of the Review include: *Special Methods on High-School Level,* February 1932; *Educational Tests and Their Uses,* February 1933; *Psychology of Learning, General Methods of Teaching, and Supervision,* October 1933; *The Curriculum,* April 1934; and *Psychology and Methods in the High School and College,* December 1934. These previous issues of the Review of Educational Research are available by purchase from the Association. See outside back cover of this issue for rates.

AMERICAN EDUCATIONAL RESEARCH ASSOCIATION
A Department of the
NATIONAL EDUCATION ASSOCIATION
1201 SIXTEENTH STREET NORTHWEST
WASHINGTON, D. C.

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Active members of the Association pay dues of $5.00 per year. Of this amount, $4.00 is for subscription to the Review. See back inside cover page of this issue. The Review is published in February, April, June, October, and December each year.

Entered as second-class matter April 10, 1931, at the post office at Washington, D. C., under the Act of August 24, 1912.

Current Edn.
Issued
Listed
13.8.70
A 173

REVIEW OF EDUCATIONAL RESEARCH

Official Publication of the American Educational Research Association, a department of the National Education Association.

The contents of the REVIEW are listed in the EDUCATION INDEX

Volume V **February, 1935** **Number 1**

478 Z 114A

SPECIAL METHODS AND PSYCHOLOGY OF THE ELEMENTARY-SCHOOL SUBJECTS

(Literature reviewed from October 1, 1931, to July 1, 1934)

Prepared by the Committee on Special Methods and Psychology of the School Subjects in the Elementary School: Frederick S. Breed, Clifford Woody, Josephine H. MacLatchy, L. J. Brueckner, and Arthur I. Gates, *Chairman;* with the cooperation of Vernon Jones, Harry A. Greene, S. C. Garrison, Ruth Strang, William S. Gray, Samuel Ralph Powers, and Edgar B. Wesley; and with the assistance of Mildred Van Nest, Ernest Horn, and G. A. Yoakam.

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FOREWORD

This number of the *Review of Educational Research* continues to exhibit the advantage of the narrower span of time covered by the reviews of the second cycle of topics. The authors have been able to summarize the results of the studies they review as well as to point out the problems attacked. Some of them go even beyond this and add general summaries of the studies as a whole. This means that the reader may get a fair idea of the findings on a given subject even without consulting the original sources.

A new plan of making the reviews, suggested in the annual meeting of the American Educational Research Association, has been tried by Dr. Gray in his review of reading, namely, the plan of getting cooperation and criticism from other specialists. If this procedure meets with approval it may be adopted by other reviewers.

Frank N. Freeman,
Chairman of the Editorial Board.

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INTRODUCTION

This number of the *Review of Educational Research* represents a consolidation of the materials previously reviewed in two issues: *Special Methods in the Elementary School* and *Psychology of the School Subjects.* The change was made to avoid the alternative difficulties of overlapping or incompleteness, which the publication of two reviews on closely related topics produced.

The present issue includes all of the topics treated in the two former volumes with exception of the following: music, which is difficult to divide into elementary- and secondary-school levels and which has been reviewed in the issue covering the latter level; and handwriting and industrial arts, in which fields the studies were too few to justify a report.

The editorial committee will welcome comments on the experiment embodied in developing the review of studies in reading. The plan used is explained in the introductory paragraphs of the chapter. Suggestions of other methods of attempting to make the *Review* more comprehensive and serviceable will also be welcomed.

All reviews herein cover the literature published between the period surveyed in the preceding *Review* on the topic and July 1, 1934.

Arthur I. Gates, *Chairman,*
Committee on Special Methods and Psychology
of the School Subjects in the Elementary School.

CHAPTER I

Activities in the Nursery School, Kindergarten, and Elementary Grades

ACTIVITY—doing as a way of learning—has been the accepted method in the nursery school and kindergarten, and the version of it suited to the grades of the elementary school is being sought by eager investigators. The prevailing interpretations now practiced in the nursery school, the kindergarten, and the first grade expressed as the consensus of large groups of teachers and specialists are given by Langdon (56). The ratings on the list of activities were made by 1,624 teachers and specialists, representing 188 nursery schools, 722 kindergartens, and 711 first grades, and came from public and private schools of cities of all sizes.

Methods in the nursery school are concerned with the acquisition of habits of personal care, of play with others, of working with materials. In the kindergarten these activities must have an end and are judged by the purposes for which they were intended. The issue in the first grade is often clouded by the subjectmatter demands imposed by the higher grades. The reader may judge here the consensus interpretations given by Langdon by recourse to references to some of the research studies of the past three years bearing on the topics.

Habits of Personal Care

Nursery schools—The teachers in the nursery school are concerned with the child's achieving independent habits of eating and the custom of accepting the food set before him. They are intent upon his learning habits of resting quietly, relaxing, and sleeping. They are most concerned with his physical welfare.

No studies were found appraising ways of teaching a child to eat or of enticing him to relax. Three collaborators (84), however, after checking the dietaries of 163 nursery-school children with their health records, suggested a new standard of calory distribution in diets for two-, three-, and four-year-olds. Vance (95) and Prentiss and Jones (77) reported food preferences of young children. Prentiss and Jones found that the older children in nursery school refuse food less often than do the younger children and more often ask for second helpings. Scott (85) found the mean length of a nap was 73.75 minutes, and the average going-to-sleep interval was 38 minutes. Shinn (86) found that naps grew shorter and the tendency toward napping grew weaker with the four-year-olds and five-year-olds. Conrad and Jones (13) found that infectious colds caused a large percent of absence in the nursery school of the University of California, while

Updegraff (92) found that among nursery-school children the incidence of communicable disease was 8.8 per hundred; among children not attending the nursery school it was 18.9 per hundred.

Kindergarten—Kindergarten teachers place emphasis upon socially acceptable table manners. They are concerned with the need of rest after strenuous exercise, and consider the protection of the children's health important. No studies were found appraising these activities in the kindergarten.

Elementary school—The intentions of the first-grade teachers resemble those of the kindergartners in regard to habits of personal care. No studies of these phases of child life were found in the elementary grades.

Development of Social Behavior

Nursery school—Langdon (56) found that nursery-school teachers place "major emphasis on those acts directed toward the guidance of the children in learning independence in personal care, self-control, respect for property rights, and beginnings of consideration for others."

Greene (29) found that children who had attended nursery school reacted more positively in kindergarten than children who had not, and any maladjustment that they showed was traceable to boredom originating in duplication. Ezekiel (24), using only four subjects, found that children dominantly egocentric on entrance to nursery school make few changes during the first three months, but unaggressive children become more egocentric in play. Updegraff and Herbst (93) found that three-year-olds made more verbal suggestions to their partners in play and accepted more suggestions, talked more to them, and were more cooperative than two-year-olds. They also reported that behavior of a social and cooperative type occurred more frequently during play with clay, while non-social and non-cooperative behavior had higher frequency during play with blocks. Green (28) found that while playing with sand the children were most quarrelsome. Kawin (52) found certain home factors significantly related to the child's social adjustment: the social and economic status of the child's family, the relationship and attitude of the father to the child, and the agreement of the parents in regard to the child's training.

Kindergarten—The consensus of kindergartners is that with five-year-olds emphasis should be placed upon independence in thinking, respect for property rights, taking turns, neatness and orderliness, and consideration for others (56).

The experimental studies related to this topic, rather than dealing with ways of developing these social traits, are concerned with verifying their presence and measuring them. Williamson (102) found from ratings given 125 kindergarten children on the Adams-Kinsman Chart for Recording Individual Interests and Progress in Kindergarten that self-dependence and responsibility are affected more by the age of the child than by his position in the family, by the supervision of nurse or governess while at home, or by previous attendance at nursery school. Bacon (5) described a rating chart for thirty-five traits devised by a group of kindergartners the use of which was "feasible and desirable." They found that measurable improvement in these traits occurred during the year in the kindergarten. M. L. Fisher (26) discussed measured differences between problem and nonproblem children, and Remer (80) studied the traits which handicap children entering the kindergarten.

Elementary school—No studies of activities in the elementary school gave objective evidence of the development of social attributes or of ways of improving them. The adaptation of some of the technics now being used on other educational levels could effectively be used in the devising of tests suited to measure these traits in children.

Uses of Art Materials, Books, and Music

Nursery school—Langdon (56) found that in the use of the materials of manipulative and fine arts the major attention in the nursery school is given to free and incidental experimentation with clay, paints, and pencils, but that practically no attention is called to the finished product; emphasis is given to acquaintance with books and pictures, and to the enjoyment of music.

Olney (74) found that pictures with mechanical content are highest in attention value, and those with dramatic content next highest. Color enhanced the attention value of the pictures. Freeman and Freeman (27), in investigating the interest of children in picture books, found a marked preference for brightly colored illustrations of simple and familiar subjects. Arlitt and Palasky (3) found that among two-, three-, and four-year-old children colored pictures were preferred to black and white in the same proportions; but there was a gradual increase with age in the percent that chose harmoniously colored pictures as against pictures lacking in color harmony. Jasper (48) found no positive relationship between either mental age or rhythm in tapping and the recognition of graphic rhythm, but there was a positive relationship to chronological age. Knauber (55) found that nursery-school children will attempt to draw things that are new and interesting without regard to pattern and that differences in interest in drawing are discoverable even among two-year-olds.

Kindergarten and elementary school—Attention in fine and manipulative arts in the kindergarten is given to the product in terms of its use in the activity being carried on. The children are encouraged in the handling and use of books, in listening to stories, and in retelling stories themselves. In music, emphasis is placed on the acquisition of skill in singing and rhythmic expression with less emphasis than in the nursery school on the enjoyment of music.

Again the studies to be reported are exploratory, determining the abilities of the children, but the findings of such studies can contribute to the methods used and purposes set. A series of art studies has been carried on at the University of Iowa in which children between the ages of two and ten have been the subjects. Meier (68), director of these studies, stated that in one group of studies the hypothesis accepted was that various phases of artistic capacity probably have a genetic emergence:

> The studies in their findings point to the conclusion that children not only do respond positively to the more fundamental esthetic qualities or principles but do so, as in the case of balance (15) and rhythm (48), as early as the second or third year in certain individuals and by the fifth year in significant group averages. Unity (99) and fitness show up in group averages several years later but color harmony (100) not until nearly the twelfth year.

These findings tend to support the view that " 'esthetic intelligence' as an important element in artistic genius matures early in life." The second group of studies (20, 31, 83, 90), in which children from five to ten years of age were subjects, led to the conclusion that "the artistically promising child is marked by the way he responds to his visual world." Knauber (55) found that kindergarten children are more interested in drawing things for which they have learned a pattern. Mellinger (69) found that children in the first, third, and fifth grades are more interested in colored pictures than in the same pictures in black and white, and that they prefer realistic to conventionalized pictures. Gunther (32) found that by manipulating raw materials in an activity situation, pupils of the third, fourth, fifth, and sixth grades learned their characteristics and properties better than by conventionalized instructional methods.

No studies were found dealing with story interests, and only one study in music in which the conclusion was that "the mean pitch level used by preschool and primary children is significantly lower than the pitch level for the same songs as they are printed in song books for those ages." The mean pitch range of the children studied was 9.5 semitones as compared with 10.5 semitones of the children's song books. Extensive practice and instruction over a period of five weeks had no significant effect on the pitch level of the children's singing (37).

Play

Nursery school—Langdon (56) reported that the emphasis in play activities in the nursery school is given to acts which follow the choices of the children and "supplement their interest with information or help in achieving skill in things spontaneously attempted." In the use of play materials the nursery-school teachers emphasize free experimentation with many materials, and some guidance is given so that the children will discover their possibilities. No effort in dramatic play is made toward the achievement of any purpose other than the children's spontaneous activity.

Arrington (4) found that two-year-olds spent about three-fourths of their free time actively experimenting with material, one-eighth in activity not involving material, and one-eighth in passive pursuits. Dow (20) found that artistic children responded more to equipment and less to physical activity and social play than non-artistic children. Arrington (4) and Beaver (8) found that the number of social contacts in play increase with age and become markedly more verbal in character. Parten (76) found social participation dependent to a large extent on the age of the child. Van Alstyne (94) found marked differences in usage of materials which correlated positively with chronological age. Benjamin (10), studying the toy preferences of boys and girls, designated some toys as masculine toys and others as feminine.

Kindergarten—Play in the kindergarten is more purposeful than in nursery school. Emphasis is put upon discrimination in the selection of materials to be used in carrying out some activity in which the children are interested. The teacher follows the lead of the children, but tries to stimulate them to discuss the results obtained.

Hubsch and Reininger (45) found that the play activities of kindergarten children must have meaning or names that suggest meaning to the children, but the children do not generally ornament, change, or animate the games and playthings. In the selection of playmates, girls tend to form cliques based upon personal attachment, but boys join together in cooperative groups.

Elementary school—In the Langdon survey (56) the attitude toward play in the first grade only is discussed. Attention there is centered on "definitely organized group activities with little apparent attention to play of an individual nature." Emphasis is on the use of materials in carrying out some activity and the critical evaluation of results achieved through their use. In dramatic play emphasis is put upon planning and carrying out the activity and following the pattern of the story set up, with group discussion of the results.

L. E. Wright (104) told of a "first grade at work" in Lincoln School in which activity with no formal instruction in reading was the source of the information gathered. Crawford and Gray (14) found that an activity built around a puppet-show in a fifth-grade English class resulted after five months in an average vocabulary gain of 7.8 months, a reading comprehension gain of 8.1 months, and a language usage gain of 8.1 months.

Learning, Language, and Subjectmatter

Nursery school: learning and language—Few verbal generalizations are made concerning experience in the nursery school, but the child is shown frequently how to do some act with as little explaining as possible. There is practically no effort to make the child critical of his own work, and group opinion is rarely used.

Matheson (67) found that the most frequent responses to a learning situation of a group of children, ages thirty to fifty-four months, were those of trial and error and "feelings of incapacity." Harter (36) found considerable over trial and error in attack on non-verbal problems; successful children tended to be older chronologically and mentally. Roberts (82) found that learning ability is more closely related to mental age than to chronological age, but that the application of the solution to similar solutions was not as much a function of mental age as was the learning of the solution. Hilgard (40) and Jersild (49) gave evidence of the importance of maturation as a factor in learning. Roberts (81), with groups of children from two to five years nine months, found that all children solved the problems in which a single relationship was held constant, but not all of them discovered the principle involved. In all groups except the two-year-olds, there was a reduction in number of trials from early to later series which tended to increase with age. Grigsby (30) found that in the development of concepts of relationships gradations of maturity were affected more by mental age than by chronological age. Chase (12) found evidence in favor of some incentive for the child above that of knowledge of results. Emmons (23), computing self-assurance on a seven-point scale, found that it is correlated positively with skill, chronological age, and intelligence. Pyles (78) found that verbalization served as a distinct aid in learning and that interest factors influence learning. E. A. Davis (16), investigating the questions asked by boys and girls between the ages of three and twelve years, found no age or sex differences in the tendency to ask a series of logically related questions starting from a single topic. The younger children did not ask questions at a rate faster than the older children, and their questions contained fewer words than those of the older children. The interests of the younger boys and girls seemed similar. Younger children ask more questions of cause than older children. Of the questions asked, 86 percent were asked of adults, and 13 percent of children; 88 percent of the questions seemed to result from the immediate situation and 11 percent from remote events.

M. S. Fisher (25) found that language patterns are more clearly related to chronological age than to mental age; that at the age of five children have acquired all of the language patterns used by adults in ordinary conversation; and that the language patterns used by children reveal them to be egotists and yet sociable. Arrington (4) found the vocalizations of two-year-old children to be predominately non-social; at three years the social vocalizations predominated. The findings of H. M. Williams (101), who measured ability to produce speech sounds, language usage in communication speech, and vocabulary, indicated considerable specialization of function in language.

Wellman and others (98) found a high correlation between ability to give speech sounds correctly and chronological age. When the chronological age was held constant, there was no correlation with mental age. Final sounds were more difficult than the initial or medial sounds, and nasals were easier than stops and fricatives. Three-year-old children sounded correctly 82.5 percent of diphthongs, 75.2 percent of vowels, 68.4 percent of consonant elements, and 51.8 percent of consonant blends. Sommer (89) found that preschool children with articulatory defects showed improvement in articulation after a twelve-weeks' interval regardless of whether or not they had been trained systematically during the interval, but the improvement in the trained group was 57 percent; in the untrained, 28 percent.

Nursery school: subjectmatter—Langdon (56) said that, in guiding the children to an understanding of number, attention in the nursery school is given to the incidental understanding of words denoting time, space, and distance. Simpkins (87) recorded while observing nursery-school children 132 occasions on which numbers were used by the children. She noted few instances of oral counting; most of the numerical experiences dealt with the object seen, handled, or touched. Numbers were constantly and consistently used in conversation and during play. Terms, such as "quart," "pint," "mile," "block," "dozen," "add," "dollar," which the children had heard used and remembered, appeared in their conversation. Grigsby (30) found that three-year-old children could count to an average of 1.64, and four-year-olds to an average of 12.44. McLaughlin (64) found that the "aggregate 2" was known by some of the nursery-school children she tested in the third year of age and by all of them in the fifth year; 3 was known by the brighest in the third year, by two-thirds in the fourth year, and by all in the fifth year; 4 and 5 were recognized by some in the fourth year and by more in the fifth year. In the fifth year, groups to be counted were counted by ones or broken up into smaller aggregates. She also concluded that the recognition of aggregates is closely associated with "maturity in counting which is the *sine qua non* of its development." Nursery-school teachers should be conscious of the importance of this early familiarity with number.

Kindergarten: learning and language—Group discussion is frequently used in the kindergarten as a means of judging the value of the activity in which the group is engaged. Generalizations are often drawn from experience. Telling and explaining are frequently used rather than showing how an act is done. Interest is often stimulated by telling the children about happenings or events which have occurred outside their immediate experience.

Jones and Dunn (50) used four sets of stimulus cards, each set presenting systematic changes in a single variable, to investigate relative choice of kindergarten children. They found wide individual differences in the tendency toward relative choice. The frequency of relative choice was related to the efficiency with which discrimination was established in the training series.

In the investigation of Wellman and others (98) the percents of five-year-old children who could give correctly the sounds of diphthongs, vowels, consonant elements, and consonant blends all closely approached 90. Sommer (89) found that the amount of improvement in articulatory defects was approximately the same in the kindergarten control and experimental groups as in the similar nursery-school groups.

Kindergarten: subjectmatter—Direct attention in the kindergarten is given to the use of number in the activities of the day, and attention is sometimes turned to various quantitative relationships. No attention to reading instruction is given, but through listening to stories read to the group and through familiarity with picture books, the child's readiness for reading is developed.

Simpkins (87) reported 333 references to numbers made by the members of the kindergarten group which she observed. Evidences of the use of counting appeared 2,817 times, and counting in unison was noted several times during play. Uses of the fundamental processes appeared 118 times: addition, 39 times; subtraction, 11 times; multiplication, 28 times; and division, 18 times. Mentions of fractional parts were common; terms of measurement, "quart," "pint," "nickel," "penny," "dollar," "two-cent stamp," were used; meaningful terms, "whole," "double," "both," "add," "pair," were overheard; and items in serial order, first to fifth, were referred to. Grigsby (30) found that five- and six-year-old children could count to an average of 19.05 and 26.5, respectively. MacLatchy (63) found that the incidental number experiences of the kindergarten gave to 708 six-year-olds at Cincinnati higher percents of familiarity with certain addition combinations than were attained by 349 six-year-olds who had not attended kindergarten.

No direct appraisals of the methods of preparing children for reading are given, but tests of readiness have been devised, such as the reading test included in the Metropolitan Readiness Tests for Kindergarten and Grade I. Hildreth (38) found that there is considerable homogeneity in the information possessed by a group of first-grade children when they enter school. Legrun (58) gathered a sampling of writings by kindergarten children who had had no definite instruction in writing but who were asked to write letters to Santa Claus. He found several stages represented: entirely incoherent marks seemed the earliest stage; then flowing lines in a horizontal direction; then a profusion of waves and zigzags; and finally the appearance of letters and figures. Hildreth (39) found that the ability of four-, five-, and six-year-old pupils to write numbers and letters progressed from a low to a high degree of success.

Elementary school: learning and language—No studies involving elementary-school children in which learning itself was isolated for study and only one in which language was especially differentiated from subjectmatter content were found.[1] E. A. Davis (16) found that the distribution of causal questions by age of children shows a drop occurring at about the time the child is learning to read. There is an increase in the number of questions of calculation with the beginning of the school age, but the difference is not statistically significant. Language is the chief vehicle of instruction in the elementary school. Many schools, frequently designated as "progressive," are attempting to present the information to be learned in a meaningful context and to deepen understanding through the manipulation of related materials so that the process of learning may more closely resemble experience.

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[1] The facts regarding children's understanding of what they see in a moving picture and their tendencies toward retaining the information so gained have implications for education which the school cannot afford to overlook. See Holaday and Stoddard's *Getting Ideas from the Movies* (42).

Elementary school: subjectmatter—Three studies were found in which conventional methods were contrasted with activity programs. Tutt (91) by a test found that first-grade children learned more words during a daily workbook period than during a daily activity period in which some reading was involved. Lee (57), testing 3,822 first-grade children in 144 classrooms, found that pupils whose programs involved a "great deal" of activity made a median score of 1.3; those doing "some" activity, 1.7; those having "very little," 1.5 and those (14 pupils) having none, 1.9. He concluded "that pupils in classrooms doing a great deal of activity work do not learn to read so well as do other pupils." MacLeod (65) compared the records of first- and second-grade pupils in art, music, hygiene, language, and nature study taught by "activity methods" with records in reading, spelling, arithmetic, and writing taught by traditional methods and concluded that first-grade children profited most by the activity methods.

The accounts of unit studies at the Lincoln School of Teachers College, Columbia University, which covered a year's work in each grade, grade two, *Carrying the Mail* (46); grade three, *Indian Life and Dutch Colonial Settlement* (53); grade four, *Adventuring with Toys* (22); grade five, *Ships and Navigation* (7); and grade six, *Children and Architecture* (6)—tell of activity programs carried on under almost ideal circumstances, with small selected groups, well-trained teachers, unlimited supplementary opportunities in the way of museums and libraries, and varied environmental facilities. In each of these studies, progress measured by a standardized test of reading, spelling, and arithmetic covers little more than a year's span on the test. Unfortunately, no measure is available to estimate the progress, mentioned by each teacher, in attitudes, interests, and habits.

Through the cooperation of a fifth-grade teacher at Cleveland, Harap and Mapes (35, 66) studied the progress of a group of pupils learning multiplication of fractions through manipulations of fractions in real situations, such as manifolding recipes for candy, toothpaste, glue, and the like. The value of these intensely interesting accounts could have been greatly enhanced had the experiment been preceded by checks of the children's familiarity with the multiplication of fractions and followed by measures of their ability to apply this knowledge in the manipulations of a variety of fractions and to transfer its use to other situations. In the reviewer's opinion there would have been no weakening of the activity value of these experiences had the learning period been extended to include analogous workbook exercises taken from other fields which could have resembled in form the exercises used by Tyler in testing university students' power to draw inferences.[1]

Studies of another type which yield material informing both to the teacher, interested in the use of activity methods, and to the research worker, interested in the nature of the processes involved and the subjectmatter covered, bear the titles, "Number Situations and Concepts in a Third-Grade 'Activity' Setting" (97), "Letter Writing in Elementary Schools" (21), "Implications of Guidance in First-Grade Teaching" (54), and "An Activity Program as a Means of Americanization in the Primary Grades" (34). Three of these master's theses were written by teachers in the Laboratory School, Ohio State University, during their terms of office. Each is based upon a diary account of actual happenings in some phase of the work in her classroom. For example, the first thesis mentioned lists and describes the situations involving number which arose in the process of the four units of work—a pioneer study, an Eskimo study, the Dutch study, and a study of prehistoric life—engaged in during the year. Diary records in still greater detail are to be desired before it will be possible to determine those parts of knowledge which must be learned specifically and those which may be learned by implication and analogy. The authors of the "Unit Studies" from Lincoln School would have greatly increased the value of the reports to research workers and curriculum specialists had each listed, for example, the arithmetic facts used and the number problems solved by the class in the course of each unit.

Hopkins (43), editor of the series, said that in his opinion there are "essentials common to all types of elementary-school curriculums," and presented figures gathered from standardized test scores which lead to the conclusion that the "children in Lincoln School learn these essentials as well as children of like age, grade, and intelligence in general school population, even though in Lincoln School such essentials are considered of relatively less importance and are given relatively less attention than in the subject curriculum." To safeguard the "skills" which the traditional school accepts as essential to the early steps in learning, a school at Long Beach over a two-year period, although organized on an integrated program, allotted an hour a day "to those skills not growing out of the units of work" (44).

Morrison (72) attempted to compile criteria for judging activities. Meriam (70) examined the records of more than a thousand activities, searching for common elements. Carey, Hanna, and Meriam (11) compiled a list of more than 7,000 projects. F. Wright and Nossing (103) collected a list of music materials which will be useful in an activity-curriculum. Long (60) discussed the physical facilities needed for activities, and Adams (1) has investigated the problems of initiating such a program.

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[1] Tyler, Ralph W. "Measuring the Ability To Infer." *Educational Research Bulletin* (*Ohio State University*) 9: 475-80; November 19, 1930.

CHAPTER II

Arithmetic

THIS summary is based upon 96 books, monographs, and articles published from July 1, 1930, to July 1, 1934. The close relationship between the present volume dealing with special methods in the elementary school and a previous volume involving the psychology of learning, general methods of teaching, and supervision demands a certain amount of overlapping in content and offers explanation for reviewing 39 studies which had been earlier presented in the more general treatment.

Children's Early Number Experiences

"Adjusting instruction to the needs of pupils" is a much used phrase in education, but often has little significance because there is no scientific evidence showing what the particular needs are. Investigations by MacLatchy (156, 159, 160) and Woody (197, 198, 199) presented facts concerning the knowledge of counting, measuring, and number processes before formal instruction in arithmetic is begun. Reports from these investigators reveal that children, even before the period of formal instruction in school, have considerable ability in counting, can often read simple numbers, and tell time, know the commonest units of measurement, and have some skill in dealing with simple verbal problems and simple exercises in addition and subtraction. While the success of the children on the tests submitted was surprising, Woody pointed out that many of the correct solutions were obtained very slowly and often by a circuitous method. He contended that not only the correct answer but the method of arriving at a correct solution should be taken into account in considering a child's mastery of a process and his need for further instruction. These studies by MacLatchy and Woody for the early grades are suggestive of the type of studies which should be undertaken for each age and grade in the elementary school.

Mental Age and Achievement in Arithmetic

Washburne (191) and his Committee of Seven, in attempting to determine whether there is such a thing as mental readiness for learning an arithmetical process, concluded, on the basis of five years of investigation involving 148 cities and many thousand pupils, that there is a stage in a child's mental growth, before which it is ineffective, if not futile, to teach the topic, but after which most children can learn it with reasonableness. His conclusion that no topic in arithmetic should be taught to a child until he has reached such a skill in the prerequisite topics and such a mental age level that he will have at least three chances out of four of learning the topic sufficiently well to pass a retention test six weeks later with a score of 80 percent or more, may be accepted as a working hypothesis; but the reviewer feels that much varied and intensive investigation must be made before proclaiming the optimum mental ages for teaching the various topics in arithmetic. No doubt, the effect of variation in the organization of subject-matter, the nature of previous instruction, the type of instruction in each unit, the duration of the period of teaching, and other similar factors influencing the achievement must be eliminated before the final establishment of an optimum time for teaching any given topics. Washburne (192) in another article indicated two reasons why pupils fail in arithmetic: insufficient mental development, and inadequate mastery of "foundation knowledge." Gillet (138), using the results of Washburne's Committee of Seven, presented the minimum ages requisite for mastery of eighteen topics in the fundamentals of arithmetic.

Ford (136) made an investigation involving three groups of 100 pupils in grade five in 23 schools of Louisiana having the following mean I.Q.: 118, 99, and 77.6, to determine which group made the most favorable ratio of success in given learning exercises as a result of a period of twelve weeks of instruction. He found the higher the intelligence the higher the net gain in scores made on the history and arithmetic tests, but the lower the intelligence the less the relative net gain. A. W. Brown and Lind (113), working on this relationship of achievement to mental age with feeble-minded and dependent children, concluded that the relationship depended not so much upon the level of intelligence as upon the position of that level in the group receiving instruction. Even among dull as among bright children the relatively bright children of the group are not working up to capacity.

Grossnickle (141) found no relation between intelligence and accuracy in solving problems by methods of long and short division or between speed and accuracy. However, he found that the pupils in the upper half in mental ability had greater speed in short division than those in the lower half. Bowman (111) reported that pupils of high ability showed no distinct preference for the types of problems which they liked best; that they performed equally well on all types presented; and that pupils of low ability preferred and performed better on problems involving no complex situations. Sauble (182) discovered that pupils in all intelligence levels profited almost equally well from the increased time devoted to the drill in the fundamental operations in grade two. She indicated that the over-age pupils profited most from the increased time expenditure. Osburn and Foltz (170) signified in their study on the permanence of improvement in the fundamentals of arithmetic that the brighter students, except those making scores near the top of the first test, made larger gains as a result of a program of remedial instruction and made smaller losses during the summer vacation. Brownell (116), in his investigation on the use of "crutches," reported no relationship between the retention of the use of the "crutch" and chronological age, mental age, intelligence quotient, or separate measures of arithmetic ability. F. T. Wilson (194), in attempting to ascertain the effect of the form of a combination in the learning of a multiplication table by bright and dull children, reported that: (a) there was no essential difference in the difficulty of the two forms used; (b) the hardest combinations for the dull children were also the hardest for the bright, and vice versa; and (c) the learning process seemed to be much the same for bright and dull pupils. Both Overman (172, 173) and Osburn and Drennan (171) found much greater transfer of training among the brighter pupils. While the scope of most of these investigations has been narrow, the investigations point to three conclusions: the relative independence of mental capacity and certain types of achievement; similarity in the patterns of learning of bright and dull children; and the greater amount of transfer among pupils of higher mental ability.

Method of Teaching

Subtraction—G. M. Wilson (195), basing his article on Allen's master's thesis at Boston University, reported results of 400 returns from instructors and teachers in 23 departments of education, 162 cities, and 215 training schools. These results revealed that 48 percent of the total replies used the "take-away-borrowing-upward method." Among this group the take-away method is used nearly three times as often as the additive; the borrowing or decomposition method, two and one-half times as often as the equal-additions; the upward method, six times as often as the downward. These results seem to have real significance and may be a cause of many pupils, even though taught by the additive method, reverting later to the take-away method. Furthermore, the fact that teachers favor the take-away-borrowing-upward method may contribute to the difficulty of permanently establishing any other method of teaching subtraction, even though experimental studies may indicate that other methods result in superior achievement. Johnson (149) found in an investigation, involving the responses to devised tests in subtraction made by 693 individuals, ranging from those in grade five to those in the normal college and university, that the individuals using the equal-additions method were 3.35 percent more accurate and required 14.3 percent less time than the group using the decomposition method. This finding is similar to the results given in a majority of the studies reported in other sources published previous to the period covered by this book. The experimental evidence seems to favor the additive method, yet as Wilson's investigation revealed, usage tends to favor the take-away method. Since the actual difference between the two methods is small it may be that more important problems can be found for future investigation. At least there is need for better controlled and more extensive investigations measuring the effects of the method of teaching, not only on the mere fact of learning the combinations per se, but on the influence of the methods as they function in the various arithmetical processes.

Short versus long division—A suggestion by a recent authority on the teaching of arithmetic to the effect that long division should be taught before short division has created much interest in the problem. Olander and Sharp (167), in an investigation involving 1,265 pupils in grades four to twelve in four school systems, found that three out of four pupils prefer the long division form and that those using this form are more accurate than those using the short division form. They concluded that "teachers should not only teach long division first, but that they should teach it as the regular method that will be used by the majority of the pupils." Grossnickle (141) found that the long division form was superior to the short division form in securing both speed and accuracy in dividing with a one-figure divisor. His conclusion was based upon results obtained from 2,365 pupils in grades five to fifteen. It is highly possible that if long division, as advocated by these investigators, were the only method of division taught, the grade placement of short and long division as reported by Washburne would be somewhat altered.

Grossnickle (140, 142, 143) reported three investigations involving the method of estimating the quotient. After analysis of 44,550 examples he recommended the use of the "apparent method" of estimating the quotient for all two-figure divisors ending in 1 to 8, inclusive, and that divisors ending in 9 be increased by 1. After analyzing and counting the opportunities for practice in estimating the quotient, he found a wide range in the amount of practice offered. An analysis of nine different texts for grade three to six for cues in problems in division showed that 25 cues for one-step problems and 4 cues for more than one-step problems appeared in at least six of the nine books. While there was much variation in the number and type of cues given, the author argues that the list of 29 cues should constitute a core of minimum essentials for grades three to six.

Learning conditions—F. J. Brown (114) asked whether, under normal classroom conditions, progress in arithmetic is greater when pupils know their scores than when they do not know them. In a carefully controlled investigation involving 138 pupils in grades 5A and 7A divided into groups matched according to intelligence and teacher ratings, and serving first as a control and then as an experimental group, he found that knowledge of results tended to increase efficiency in drill in the four fundamentals in arithmetic. He found that boys were more susceptible to this influence than girls.

Sauble (182) matched classes in grades 2B and 2A with classes in the same grades, with the same mental ability, age, race, nationality, teachers, materials, and methods, except that the experimental group spent an extra ten minutes in drill on the combinations. He reported that the additional results obtained were not proportionate to the extra time expenditure. There was virtually no difference in the gains in grade 2A, although the extra time brought some increased achievement in grade 2B, especially among the over-age pupils.

Brownell (116) made a contribution to the psychology of learning in his investigation, involving 248 pupils in seven schools, on the effects of the use of a "crutch" in adding proper fractions. He found that the groups using the crutch did approximately as well as the non-crutch group, that both groups made the same kind of mistakes; and that the group using the crutches tended to drop them in spite of the teacher's efforts to preserve them. He concluded that none of the objections against the use of crutches, which were studied in his investigation, were found to be valid. Implications from this investigation and from a recent article (117) suggest that the crutch may be used by the child in one stage of his learning and be eliminated almost automatically as higher stages of development are attained. His investigation surely suggests the need for studying intensively the method by which a child masters any new process.

Abstract versus meaningful drill—G. M. Wilson (196) experimented for three years with substituting activities and experience for the formal drills in arithmetic in grades one and two and to some extent in grade three. He found that 475 children, in a school with a large foreign element, at the end of grade two, when tested on the 100 addition combinations, were superior to the pupils in grade two in a much better neighborhood, and better than the pupils in grade three in a comparable neighborhood. He found also that when the Wilson Survey Test was given in May to 1,034 pupils in grade three the average percents correct in addition and in subtraction were 97.8 and 95.6, respectively; the percents of children making perfect scores in addition and in subtraction were 82 and 74, respectively. Hizer and Harap (147) found that the course of study involving the learning of decimals can be organized into a series of activities without neglecting the mastery of the fundamentals. On the basis of their investigation they concluded that "it seems safe to recommend a series of child-centered activities provided they are accompanied by individual practice exercises for pupils, if and when they are needed, plus periodic tests of mastery of the essential steps." Harap and Mapes (146) reached similar conclusions. The authors, making no effort to control the order of occurrence of the steps in a process or the number of repetitions, presented results to show that pupils have understanding and surprising mastery of the subjectmatter under consideration.

Familiarity with problem situation—Six different studies are concerned primarily with the familiarity and interest of pupils in the problem situations involved in the statements of verbal problems. Brownell and Stretch (115), in an investigation dealing with the responses of 256 pupils in grade five to problems in four different settings of different degrees of familiarity as judged by teachers, found on the basis of gross scores that unfamiliarity of settings decreases the number of correct solutions by interfering with the choice of operations rather than with the quality of the computations.

They reported that there is evidence for believing that the influence of unfamiliar settings is conditioned by the difficulty, aside from the setting; the number of times a given set of number relations has been dealt with; and the amount of time allotted for solution. They furthermore found in the study of individual children that the children's choices of operations for dealing with the same relationship vary without regard to the setting; that unfamiliarity is a factor which does not generally operate; and that the pupils most affected by unfamiliarity of setting are those who are usually poor in choice of operation and in computation. G. A. Kramer (151) in a very extensive study to determine the effect of interest, sentence form, language details, and familiarity of vocabulary in grade six, found that pupils made highest scores on problems remote in interest, stated in interrogative form with plain statement and familiar vocabulary, and that they made the lowest scores on problems employing the declarative form with unfamiliar vocabulary and language details. She found that children tended to respond to cues rather than to the facts and requirements of the problems. White (193), in an investigation in grade 6B, in which 1,000 children responded to a test with twelve problems stated in familiar situations and a similar number of problems of equal difficulty stated in unfamiliar situations, found that in other than easy problems the non-familiar situation was a highly significant factor in the selection of wrong processes, in omission of problems, and in the failure to complete a problem. Bowman (110, 111, 112) reported that the order of preference of 564 pupils in grades seven, eight, and nine, when given a chance to check from a list of problems the ones best liked, was as follows: (a) computation, (b) child situations, (c) adult situations, (d) science situations, (e) puzzle situations. He found the correlation between preference and performance on the total list was .58; between preference and the preferred list, .56. These correlations suggest that preference had little influence on achievement. Both groups rate the child-type of problem high. The pupils of high ability show no distinct preference and perform equally well on all types of problems; pupils of low ability prefer and perform better on problems involving no complex situations.

The results presented in this group of studies are not consistent and may suggest to those interested in the doctrine of interest, meaningful experience, and activity teaching, the need for further experimentation. It may be that uncontrolled factors in each situation concerned are responsible for the results obtained. Each of these investigations has been based upon testing and not upon teaching situations. Furthermore, these investigations involve tests after the pupils are supposed to have developed the technic of solving the problems and whatever generalization may ensue. A caution must be added lest implications manifested in a testing situation after teaching should be applied to a situation in which a new process is to be taught. An additional caution may be mentioned lest someone will infer a causal relationship for two conditions that happen to exist simultaneously.

Method of presentation—Baker (108), after an investigation covering a period of eighteen weeks using two radio lessons per week accompanied by drill sheets and a test every sixth lesson, presented results showing the superiority of the radio schools over the control schools and claimed that results in grades 2A, 3B, and 3A are very encouraging. Zyve (202), in comparing the relative effects from presenting number combinations on the blackboard or by means of lantern slides, concluded that evidence favors presentation by means of lantern slides. This conclusion may not have significance since there were only 37 pupils in grade two and 39 in grade three, and since the novelty of the method of presentation by means of the lantern may not have worn off during the short period of the investigation. Brueckner and Hawkinson (119) and Capron (125) made studies on the order of arrangement of items in tests on the difficulty of the items. The former tested the relative effects of arranging four examples of one type on the same horizontal line and of arranging the examples of all types in random order. The latter tested the effects of arranging a series of examples from easy to hard, hard to easy, or in random order. Both found that order of arrangement has little influence on difficulty. Brueckner and Hawkinson, however, stated that, because of greater ease in scoring and analysis, all examples of a type should be placed in a horizontal row.

Transfer of Training

Three investigations are reported under this heading. Those by Overman (172, 173) and Olander (166, 169) are outstanding and suggest that the amount of transfer is greater than usually anticipated and that the amount can be influenced by methods of teaching. Overman's investigation involved fifty-two classes in grade two divided into four groups matched according to age, sex, mental age, teacher's estimate of general ability, and score on an initial test in arithmetic. Four methods of teaching were employed in the teaching of the group: specific training, generalization, rationalization, and a combination of generalization and rationalization. He measured the effects of teaching simple exercises involving addition of a single column of digits upon more complicated types of addition and subtraction. He exercised most careful controls. He found considerable transfer from each method. The methods ranked according to the greatest amount of transfer resulting were: generalization, generalization and rationalization, rationalization, and specific training. The pupils with the highest mental ages had greatest transfer with the method emphasizing rationalization. He also found greater transfer with the brighter than with the duller pupils. Olander's findings (166, 169) corroborated the implications of Overman. He found on the results obtained from 1,300 pupils in grade 2B in Detroit, Fordson, and Hamtramck, Michigan, in learning 100 basic combinations in addition and in subtraction, that the group whose instruction included emphasis on each of the 200 combinations did not make higher achievement on the informal tests involving all combinations than the group which spent its time on 110 combinations. He concluded that the 100 facts in addition and in subtraction are not learned as separate bonds, but as a system of interrelated experiences. He found that his efforts to teach by the method of generalization showed no significant effects on the scores made by the pupils taught with emphasis on this factor, but he added that every combination does not need to be taught directly. Osburn and Drennan (171), after a special thirty-day period of training in which a series of cues useful in solving verbal problems was used, found that pupils responded especially well on new sets of problems with entirely different cues. They discovered the greatest amount of transfer with the more intelligent pupils. They concluded that emphasis should be given to the thorough teaching of the most important types of problems and that dependence should be placed on transfer effect for solving other types of problems.

These three investigations seem to the reviewer to be significant and should influence teaching. They suggest that in the past many investigations may have failed to show transfer because the various elements involved in the new situations were so unlike the teaching situations that the effect of transfer could not be detected. Designers of materials of instruction should give consideration to the findings of these investigations.

Diagnosis and Remedial Instruction

Cooke (129) reported a limited investigation in which six of the poorest pupils in arithmetic in the Peabody Demonstration School were selected for special instruction based upon each pupil's errors. He concluded that individual remedial instruction is profitable. In a follow-up study made seven months later, he (130) reported that 71 percent of the difficulties found in the period of remedial instruction previously given did not recur, but that 79 new difficulties had been added. He concluded that programs of remedial instruction must be constantly followed up or much of the real value will be lost. Bush (123), in an investigation in grades four and five on the effects of training on specific types of problems and on overcoming specific difficulties, concluded that this type of remedial instruction was superior to the usual type of instruction in which unselected examples are chosen at random. Smith and Burton (185), in comparing the relative gains in computation and reasoning in arithmetic during a period in which there is no supervision with that made in a period in which a supervisory program emphasizing computation was instituted, found that much larger gains in computation and slightly greater gains in reasoning were made during the period of supervision than in that without supervision. Gerhardt (137) reported a study showing beneficial effects of a program of remedial instruction following a citywide testing program.

Analysis of errors—A few studies involving the analysis of errors appeared during the period under consideration. Olander (168), after having made copious notes on the responses of seven pupils in taking the Buswell-John Diagnostic Test, gave the original papers to 40 teachers asking them

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to mark the papers and to surmise the thought process of each pupil in making any existing errors. He found that teachers in marking are greatly influenced by the pupil's method of work and that of all the surmises made as to the thought processes involved in the errors, only 29.7 percent were correct inferences. These results certainly suggest caution in attempting to make a diagnosis of the cause of error merely from the written responses on test papers. Burge (122), after employing the interview technic with 2,577 pupils in grades four, five, and six, concerning their responses to tests in multiplication, found that relatively few type errors and questionable habits of work could be analyzed with certainty from the written responses. He argued for the interview because he found that all errors and questionable habits of work had significance for the individual child and that they tended to persist throughout the higher grades. Brueckner and Elwell (120) raised a question of the reliability of diagnosis of error in multiplication of fractions. They found, on the basis of the responses of 327 pupils in grade five to a test of twenty-four examples, consisting of four examples of each of six types arranged in random order, that in 59.8 percent of the cases the pupils who solved correctly one example of a type, missed one or more of the remaining three; also that when two examples were missed the errors were different in 69 percent of the cases. They concluded that diagnosis of difficulty on the basis of a written report on a test containing but a single example of nine given types is likely to be unreliable and invalid. Knight and Ford (150), in studying the effect of position of the various digits in the multiplier or multiplicand on the frequency of error in the solution, discovered that 72.4 percent of the total errors came in the latter half of the solutions of the given examples. They found that difficulty of a combination was often conditioned by the lateness of its appearance in the solution of the example. They concluded that difficulty may be thought of as a temporary lapse in, or degeneration of, ability within a segment of work which disappears under the stimulus of attacking a new segment of work. Their discovery that difficulty of combinations is conditioned by position in an example may suggest caution in taking too seriously the significance of the studies on the difficulty of the combinations. F. T. Wilson (194) reported a simple study showing that in multiplying 67 by single digits the effect of form is negligible as the results were virtually identical whether the example were written: 4 x 67, 67 x 4, or in vertical form. Furthermore, the learning process was the same for both bright and dull pupils. His conclusions with regard to influence of position are somewhat contrary to those of Knight and Ford, but it should be pointed out that his examples were much simpler than those employed by the latter and the number of his subjects was much more limited.

Permanence of Improvement

Osburn and Foltz (170), in September, 1929, administered the Wisconsin Inventory Tests to all pupils in an entire county. On the basis of the results they planned a remedial program and repeated the tests the following April at the end of the school year and in September after the summer vacation. They found the average loss over the vacation was less than one-fifth of the improvement made from September to April. The range in the loss was from one-twelfth to three-fifths. The brighter pupils made greater gains and smaller losses. These investigators emphasize the fact that there is a large amount of permanent improvement in the pupil's knowledge of abstract arithmetic. Sister Mary Immaculata (152), in her investigation on the permanence of improvement and the distribution of learning in addition and subtraction, found that: (a) short periods result in greater permanence than long periods; (b) distributed practice is better than concentrated practice; (c) written drills secure greater and more permanent gains than oral drills; (d) older children tend to retain more than younger children; and (e) the loss over the summer vacation is small compared to the gain from which it proceeded. She concluded that the most economical drill is secured through spirited competitive written practice, with short, distributed periods. Schorling (184), on the basis of tests in the fundamental operations in arithmetic given to 3,545 pupils in grades five to twelve and 2,693 university freshmen, found the grade medians ranged from 17.6 in grade five to 67.0 in grade twelve. He found only nine tasks out of 100 which as many as 90 percent of the pupils in grade twelve could do perfectly; only 29 items which 80 percent of these pupils could do correctly. He found only three items which could be solved correctly by 75 percent of the freshmen. He concluded that the degree of mastery of these fundamental operations is very low. If one can assume the different items had been taught the pupils tested, his results suggest lack of permanent results. However, it should be pointed out in his investigation that there was no control over the teaching process, while in the other investigation there was definite effort for instruction on the exact processes upon which measurements of permanent effects were based.

Level of Attainment in College

Carson and Wheeler (126), in giving the Woody-McCall Mixed Fundamentals in Arithmetic Test to 163 freshmen in East Tennessee State Teachers College, ascertained that 69 failed to attain the standard for pupils of grade eight. After four weeks of specialized practice, 95 percent of those placed in a remedial class attained the standard for grade eight. Arnold (107), in giving the Monroe Diagnostic Tests in Arithmetic and the computation test of the Stanford Achievement Test to 83 and 140 freshmen, respectively, found that from one-sixth to one-third failed to attain the standard for grade eight. Guiler (144) found that 22 teachers of arithmetic in his summer school classes attained median scores on the Guiler-Christofferson Diagnostic Survey Test in Computational Arithmetic—slightly less than that usually attained by college sophomores. Lueck (155), in giving the Compass Survey Test in Arithmetic to 280 students in first-year physics in five Iowa colleges, found that the mean score approximated the standard for the low-seventh grade. Lueck (154), in another report, showed that the most frequent errors made by these students are: changing percents to decimals, dividing a proper fraction by a decimal, and dividing a mixed number by a mixed number. In general, these studies show difficulties in examples involving fractions, decimals, and denominate numbers. Cooke and Fields (131) decided on the basis of results obtained from the administration of a battery of mental tests and tests in arithmetic, algebra, and geometry to 150 pupils in high school taking beginning algebra or geometry, that the facts did not warrant recommending a review of arithmetic before proceeding to other courses, although they suggested such a review might be helpful before attempting algebra.

Problem Solving

Problem analysis—Three studies are concerned with the process involved in the solution of verbal problems. Mitchell (163), working with 117 pupils in grades seven and eight on the problem of the extent to which the analysis of problems aids in their solution, found that accompanying lists of verbal problems with analytical questions helped materially in the children's ability to solve the problems correctly. Adams (106), using 1,938 pupils in the experimental classes in which detailed analysis of the steps in the solution of verbal problems was emphasized, and 1,836 pupils in the control group in which the same problems without the analysis of the steps involved in the solution, found no differences in the results obtained in grade 4A, but found superior results in the experimental classes in grades 3A and B. He concluded that greatest gain from specific instruction in problem solving was in the grades in which problem solving is just beginning. Hanna (145), working with three groups comprising 477 pupils in grades four and seven, attempted to determine which of these methods would result in greatest gains in problem solving: (a) dependencies method, "to find the answer I must know this," etc.; (b) the conventional formula method, "what is called for"; (c) individual method, "any method the pupil desires to use." The results from his carefully controlled investigation showed the conventional formula method produced less mean gain than the other two methods. The results obtained from the dependencies and the individual methods were approximately the same. The dependencies method was especially effective with pupils of low mentality.

Influence of reading on solution of verbal problems—Three studies concerning the relationship of reading to achievement in the solution of verbal problems are reported. Stretch (189), working with a group of control and experimental pupils consisting of 32 pupils, each, in grade five, equated on the basis of reasoning in arithmetic, comprehension in reading, and general intelligence, found as a result of stressing problem solving in the experimental group that it made greater gains than the control group on both the arithmetic and reading tests. She concluded that there is a positive relationship between achievement in reading and problem solving, and that the two abilities increase together. Monroe and Engelhart (164) found no significant differences in the results obtained in thirteen classes in grade five in which reading of verbal problems was stressed, and in equated classes in which reading of verbal problems was not emphasized. They concluded that difficulties attendant upon use of experimental method rendered results uncertain. Engelhart (134), in studying the relative contribution of certain factors to individual differences in problem solving, concluded that intelligence and computational ability are important factors in causing individual differences in problem solving, but the effect of general reading ability is practically negligible. Engelhart's study is unique in that he uses the path-coefficient technic. His study involved results from 568 pupils in grade five, but his results are at variance with a number of existing studies on the relationship of achievement in reading and in the solution of verbal problems.

Factors contributing to ability to solve verbal problems—Engelhart (134), in the study just referred to, reported that ability in computation and intelligence are largely responsible for the variation in the ability to solve verbal problems. Stevens (186), upon the basis of analysis of results of achievement and mental tests from 3,089 pupils in grades three to seven by means of zero, first, and second order correlations, found that ability in the fundamental operations is more closely related to achievement in solving verbal problems than is general achievement in reading. He found, however, that results from tests in problem reading had higher correlation with results from tests in problem solving than with tests from general reading or from fundamentals in arithmetic. Neulen (165) reported the correlation between problem solving and skill in fundamental operations was considerably higher than between problem solving and general intelligence.

Miscellaneous factors influencing problem solving—Robertson (177), after testing 712 pupils in grades four to seven on two sets of verbal problems of equal difficulty, one read aloud to the pupils by the teacher and the other read silently by the pupils, discovered much higher scores on the pupil-read tests. He argued the need for practice on problems presented orally since most problems encountered in life are oral. Rosse (180), after a fifty-eight-day investigation in which practice was given by means of Lennes Test and Practice Sheets in Arithmetic, concluded that these materials are valuable in improving the ability to reason in the solution of verbal problems. Rolker (178) described a supervisory program for improvement in problem solving and presented facts to show that the pupils made real gains as a result of the program.

Selection and Arrangement of Subjectmatter

Sueltz (190) analyzed the front pages in thirty-five copies of fourteen different publications to determine the knowledge of number requisite for efficient reading. He found the total number occurring to be 3,917, with 497 different uses. Decimals with 81 different uses were employed 118 times.

Sixty-four fractions and mixed numbers were used. In general, most of his numbers were small but they ranged from .01 to 10,000,000,000. Woody (200), in his analysis of the knowledge of arithmetic needed for reading the material read in the elementary school, found in addition to his long list of arithmetical concepts and his list of commonly used simple arithmetical numbers, fractions, measures, and symbols, quite a list of rarely used fractions with large denominators, and of many less frequently used symbols and units of measurements. He concluded that the reader's knowledge of arithmetic should be much more extensive than that needed for mere calculation in the problems of everyday life.

Changes in content of textbooks—Gorman (139) analyzed the textbooks in arithmetic published in the periods: 1907-10, 1917-20, and 1927-30. In determining trends, he considered a practice typical if he found it present in 50 percent of the books published in a given period. He found three important changes: (a) from the abstract to verbal problems within the understanding of the pupils; (b) from the deductive to the inductive method with the employment of simpler language; and (c) more attention to types and classes included under general uses. He also noted a tendency in the more recent books for providing inventory, diagnostic, and progress tests, and for accompanying remedial drill. Metter (162) analyzed 55 texts representing three periods: 1860-92, 1893-1914, and 1915-33, and listed the tendencies somewhat in line with those enumerated by Gorman. Metter makes this outstanding statement: "The lists of topics recommended for elimination or for less emphasis after 1900 included a number of topics which had already disappeared, some of which were given only minor place and others which had never been given much attention and hence were an insignificant portion of the arithmetic curriculum at all times."

Difficulty of arithmetical processes—Ruch (181), in reviewing a number of studies dealing with the relative difficulty of the 100 multiplication facts, presented four observations: (a) learning difficulties are very different from final difficulties; (b) there is a rough agreement of the order of difficulties in learning in two of the studies; (c) there is considerable correlation of difficulty and size of the product; and (d) the so-called zero difficulties rise from neglect and disappear with practice under controlled instruction. He argued that these facts should be taken into consideration in constructing materials of instruction. Brueckner and Laumann (118) reported a study in which they tried to measure the reliability of judgments of ratings of a group of problems of known difficulty arranged in random order on the basis of a problem scale containing arithmetic problems of known value. They concluded that "it is doubtful whether the tedious process of testing children to determine the difficulty of problems is more reliable than the technic of having reliable judges estimate the difficulty of problems by means of a scale consisting of problems of known difficulty." If further investigation should substantiate this conclusion, the conclusion reached will be of great value to those engaged in test construction or in the preparation of materials of instruction. Brueckner and Irving (121) reported a technic for comparing the difficulty of problems in textbooks. They selected 30 problems at random from each of 10 textbooks for grade five and administered them to 100 pupils in grade five. They found that the median percents of correct solutions for the various books ranged from 30 to 54. They stated that textbook committees can easily use the technic developed.

Nature of content of textbooks—Entz (135) analyzed 16 three-book series for grades seven, eight, and nine for practice exercises in securing and maintaining computing skills in the fundamental operations. He found all books for grade seven made definite provision, ranging from 382 to 2,266 examples. Two books for grade eight made no provision; one had only about 100 examples; but the book with the highest amount of practice provided 2,323 examples. In grade nine only three books made any serious provision for practice to maintain skill in the fundamental operations. Distad (132) analyzed ten texts published between 1925 and 1930 to find the extent of abstract drill provided in division of decimals. He found 4 general types and 61 specific types of examples. No series provided drill in more than 51 of the 61 specific types; 18 types are almost entirely neglected in over one-half of the books; and the most difficult type, i.e., the integer divided by a decimal, receives the least amount of practice. The facts revealed are interesting, but whether or not they are significant may depend on the method of teaching as indicated by the results given in the section on transfer of training. Neulen (165) analyzed 24 courses of study to determine the amount of practice provided in grade placement of problems of one, two, three, and four steps and then to determine the ability of the pupils in grades three to seven to solve such problems. He discovered from the courses of study that the placement of the one-step problems ranged from grades one to four; of the two-step problems, from grades two to five. He stated that "there appears to be no close agreement among the outstanding courses of study with respect to the grade placement of problems that involve one or more reasoning steps." He found on testing the average mastery on all problems in all grades was only 34.1 percent; that in grades two and four, 60 percent mastery was attained only on two-step problems.

Evaluation of two types of drill materials—Kulp (153) described in detail experimental procedure for evaluating two types of practice material for developing skill in computation. The investigation involved 142 pupils in grade four. One set of drill materials was planned for use in grade four; the second set, partly for use in grade two and partly for use in grade four. The second set of materials produced superior results. Better results were obtained with the material designed for grade four than that designed for grade two.

Vocabulary Studies

Three significant vocabulary studies were made during the period under consideration. Pressey and Elam (174) selected 117 words as a core vocabulary absolutely essential in the study of arithmetic in the elementary school. These words were selected from four previous vocabulary studies on the basis of three criteria: (a) occurrence in the highest third in frequency in at least two of the studies; (b) rating as essential by at least half of a jury of 100 elementary-school teachers; and (c) general social value as determined by studies of uses in business, science, etc. Pressey and Moore (175), previous to the determination of the above list, had given a list of fundamental words to from 406 to 643 pupils in each grade from three to twelve and found an inadequate mastery of terminology. They suggested that lack of mastery of vocabulary is one of the most important reasons for the difficulty encountered by persons of all ages and social strata in dealing with anything of a mathematical nature. Buswell and John (124) presented a series of studies dealing with the nature and development of concepts of technical and semi-technical terms in the arithmetic of the first six grades. Among the investigations reported are: giving of group tests on the understanding of 100 arithmetical terms to 1,500 children in grades four to six; the giving of individual tests embodying 33 arithmetical words and phrases to 240 children in grades one to six; and a study of the initial explanations of a selected list of words in ten textbooks. They presented data showing enormous variation among pupils in their knowledge of the vocabulary of arithmetic. In some grades and school systems the growth in understanding of vocabulary is meager; in other grades and systems the growth is as much as 60.2 percent. Misconceptions of some terms do not decrease materially from grade four to grade six. They also found that the lack of adequate explanation of new terms and adequate drill for fixing meaning intimated these facts may be attributed to lack of growth in vocabulary on the part of the pupils. The study by Woody (200) represents an effort to determine what arithmetic vocabulary is needed for understanding and appreciating the ordinary reading which children in other elementary schools are asked to do. His study consists in analyzing 13,298 pages of reading material contained in 38 textbooks and 9 issues of magazines written for juvenile readers. His study gives a list of mathematical terms encountered and provides comparisons with other well-known lists.

Sex Differences

Only a few studies made mention of sex differences in achievement in arithmetic. MacLatchy and Buckingham reported in the *Twenty-Ninth Yearbook of the National Society for the Study of Education,* published previous to the period under consideration, no important sex differences in the results of their investigation on the knowledge of arithmetic possessed by six-year-olds. Woody (199), on the other hand, in his much more extensive investigation, found on almost all of the 204 items of his tests that a higher percent of the boys than of the girls responded correctly. He found greater differences on the harder items of the tests. The differences between the responses are rarely three times the standard error, but there is a constant tendency for the boys to be superior to the girls. He ventured to explain these differences in terms of the wider social environment of the boys and hence of greater familiarity with the type of arithmetic situations presented. He suggested that possibly the greater interest of boys than girls in later life in mathematics is conditioned by early experiences with number relationships. Dunlap (133) in studying race differences in the schools of Honolulu found no sex differences in the pupils in grades three to eight on the computation test, but that the males exceeded the females in arithmetical reasoning. Schmidberger (183), in studying the responses of 2,284 pupils in grades three to eight, to four series of problems, discovered in general no sex differences in central tendencies or dispersions; but, if the problems were weighted according to difficulty, the achievement of the boys was superior to that of the girls. The superiority of the boys was apparent for the most difficult problems. Clem and Hovey (128) found girls from village schools made higher scores than the boys from such schools, but in the rural schools the achievement of the boys was superior to that of the girls. F. J. Brown (114) found that knowledge of results achieved each day for a twenty-day drill period was a greater stimulus to the boys than to the girls. These studies may suggest the need for additional investigation of sex as a factor in the mastery of a subject like arithmetic. Adult psychology may show no significant differences in the achievement of the sexes at maturity, but that fact does not mean the non-existence of sex differences in the various stages of mental growth and maturity.

Miscellaneous Studies

Mention will be made of a few studies that seem to defy classification. Barthelmess and Boyer (109), in an effort to evaluate ability grouping, reported statistically significant differences in arithmetic in favor of homogeneously grouped as opposed to heterogeneously grouped pupils. Hollingsworth, Lacey, and Shannon (148), in submitting an inquiry to 569 teachers in Indiana, found that arithmetic was the second easiest subject to teach. The most common reasons offered were: adequate textbooks, well-organized courses of study, and thorough training in methods of teaching. Stokes (187), in comparing the effects of arithmetic and general mathematics training in grades seven and eight upon achievement in general mathematics in grade nine, found that those studying general mathematics in the early grades made higher scores on the Reeve General Mathematics Composite Scale. Carter (127), in studying family resemblances in verbal and numerical abilities, administered the Courtis Standard Research Tests in Arithmetic, Series B, to 108 families (215 parents and 230 children). Among his findings are the following: (a) a decline in ability with increasing age on the part of the husbands; (b) negative correlation with years of education for both fathers and mothers; (c) no significant sex difference among children; (d) superiority of the male adults to the female adults in arithmetic; and (e) no resemblance between husbands and wives in achievement in arithmetic. This study is important in that it emphasizes the study of hereditary influences on achievement. Merry (161) reported a survey of the achievement of 170 blind pupils in grades three to six. He found that these blind children made favorable comparison in scores on the Stevenson Arithmetic Reading Test. He said that blind children could ascertain what is to be found and the processes necessary for a solution, but that they needed instruction in enumerating the facts given and in estimating answers. Clem and Hovey (128), in comparing the achievements of 193 pupils from village schools with 196 pupils from rural schools, found the former had higher mean scores in arithmetic than the latter. Stokes and Finch (188), in comparing the norms of certain standard tests in arithmetic, gave five different tests to 65 pupils in grades seven to nine at the University of Minnesota High School. They found significant differences between the average grade levels by pairs of tests. The New Stanford Achievement Test has grade-level standards: .77 grade above those for the Van Wagenen Revision of the Woody Arithmetic Scales, and .74 grade above those for the Buckingham Scale for Problems in Arithmetic. Such discrepancies probably result from variations in the groups on which grade levels were determined and in the parts of the school year at which the grade levels were established. Dunlap (133), in studying race differences in the schools of Honolulu, discovered that Chinese, Korean, and Japanese pupils did better in arithmetic than the part Hawaiian, Filipino, and Portuguese pupils.

CHAPTER III

Character Education

The Field and Methods of Attack

CHARACTER education has only recently been opened up for experimental study, one of the pioneer objective experiments being that of Voelker only fourteen years ago. But since the time of his study, and especially since 1930, the development has been very rapid. What character education really is and what its objectives are have not yet been fully agreed upon. It is perhaps too early to set up even tentative boundary lines, but for the purposes of this review it will be necessary to define what we are reviewing and exclude certain topics. Among the studies not included are those on interests, emotional and temperamental maladjustments, psychopathic and psychotic conditions, health, educational and vocational guidance, and the development of tests which have been adequately covered in other reviews (219, 224, 227, 234, 239, 240, 242). Also, curriculum studies and specific plans for activity programs, as well as studies of character development in summer camps, clubs, churches, etc., have been excluded unless principles have been evolved which have rather general application or significance.

Probably there will be little criticism of these exclusions for practical purposes of this review, though the very mention of them indicates that they are not without interest to the student who would consider character education in its wider ramifications. Indeed it should be said that in the broadest sense all the work of the school, the home, the church, and other organizations which assists the individual to adjust his behavior to the demands of social living, is character education. In the school situation certainly all the work along such lines as educational guidance and classification, diagnostic testing and remedial teaching, mental and physical health, and the work in the socialization of the individual make contributions to character development. But since character development is more of a concomitant and not a primary aim of such work, it seems justifiable to exclude from this review any discussion of the contributions from these neighboring fields.

There are three other lines of work, however, about which decision is more difficult: first, the work on characterology; second, that involving clinical study and adjustment; and third, that involving the broadside attack on political, economic, and social beliefs. The work in characterology lays chief emphasis on the all-round study of the individual and the identification of types. Its main value to date has been its contribution to theory. To the clinical worker and to the test-builder who is concerned about the psychological and psychiatrical theory of what he is testing, this contribution is valuable. But due to the limited application which has been made of this work to education, we shall not include a review of it, but merely refer to a few representative discussions (203, 222, 246). For further references and a brief summary the reader is referred to Maller's review (226) of the German literature, where practically all the most important contributions to characterology have appeared.

The work in the clinical field, like that in characterology, is concerned with the intensive study of the individual, but it has a definitely educational bent in that it is always concerned ultimately with adjustment. Probably the teacher has much to learn from developments in this field, especially in methods of dealing with unusual cases, but ordinarily the clinician is not interested in evolving principles or methods which can be applied by teachers, and it is difficult to arrive at any generalizations to report here. There is one attitude often expressed or implied, however, in the reports and discussions from the clinical field which probably should be mentioned, namely, that the best method of character education is one of preventing or reducing the moral and emotional conflicts of the individual. For example, if fear of punishment and the desire to surpass another child in school act as motivation for lying or cheating, then the removal of the fear of punishment and the competition motive in school is the job for character education, not the attack on lying or cheating itself (217). Though the application of this point of view may seem difficult or impossible in most school situations, the appreciation of it may at least serve to assist educators to understand better some of the recommendations of psychiatrists and other clinical workers in the case of individual problem children, and certainly some teachers would do well to attempt to apply it in not overmotivating children by fear, in not placing too much stress on competition, and in not creating conflicts by ignoring the ideals which children have.

The third line of attack mentioned above, namely, that involving education on economic and social questions, will certainly be considered by some readers to be one of the major procedures in character development. A good illustration of this method is given in a study by Biddle (205). He prepared nine lessons designed to teach children to be open-minded and non-gullible to propaganda about questions involving attitudes toward international, industrial, economic, and racial problems. He arranged an equivalent-group experiment consisting of one trained group and one control. After a training period lasting several weeks he found that 73 percent of the children of the experimental group showed improvement according to his criterion. He says, however, in discussing the reactions of the children that early in the experiment some of the pupils questioned whether his lessons were not pacifistic, socialistic, and pro-German propaganda. Another program in which adult problems are attacked broadside in the teaching of children is described in a book on character education in Soviet Russia (237). This book is a translation of the specific directions issued by the educational authorities of the Soviet government for use in training Young Pioneers. "Whom shall we educate?" the book (237: 31-32) asks. "Briefly we shall educate Communists, but what does this mean? . . . To train up a Communist means to train up a collectivist, an internationalist, and a militant atheist. . . . The child should be shown the roots of egotism, individualism, and private property, the evils against which we are contending. . . ." The mention of the study by Biddle and the book on Russia may seem to be the selection of extreme cases [1]—and perhaps it is—but these two books serve to bring out clearly questions which are in the minds of many with regard to the objectives and methods in character education. Pierce (231) raised the question whether vital character education can be given without running into conflict with the prevailing mores of adult society, and whether anything can be taught in the public schools which does seriously run into such conflict.

There is one other line of attack on the character education problem, and it is with this that the rest of the review will be concerned. This attack deals with ways and means of improving children's character in connection with situations which they, as individuals and groups, meet in their daily living. This is, in general, the approach which is stressed in the Department of Superintendence Yearbook (228) on character education prepared by Freeman, Counts, Watson, Threlkeld, and others. The general method here is not one of an attack on existing institutions or adult mores, but one of teaching the child individually and in conjunction with others to practice with satisfaction in each character situation those responses which, if generalized and practiced universally, would best meet the demands of the situation for all concerned.

Following this line of procedure many experimental studies have been made on children's learning in various concrete situations, and from such studies have developed an appreciable number of facts and stimulating observations concerning methods of teaching.

Classroom Methods

General—The studies on methods in character education can be classified into two groups: first, those dealing with methods in classroom instruction, and, second, those dealing with methods involved in athletics, school discipline, informal contacts between teacher and pupil, etc. This section will be devoted to studies of the first type. Peters (230) said that the sources of character growth are social pressure, personal experience, and vicarious experience, and concluded that the province of the school is primarily one of providing this vicarious experience. Jones (221) classified the methods which have been proposed for use in classrooms as follows: direct attack through use of precepts, codes, etc.; ratings (teacher's marks and self-ratings); incidental training through regular school subjects; discussions; first-hand experiencing; and discussions coupled with first-hand experiencing. Heaton (216) gave the most complete collection of methods and materials that has appeared. Freeman (211) gave a penetrating discussion of character education from the point of view of psychology.

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[1] Several other studies—all showing that attitudes can be changed at least temporarily—might be mentioned, though the most important of these deal with students of the college level.

Incidental training—The claim has been frequently made by educators that the best method of providing for character development is through incidental work in connection with the regular school subjects, no special attention to character education being necessary. Hartshorne and May (214), however, as a result of their extensive study emphasized the great difficulty of making changes in the character of children. They do not recommend any special period for character education—far from it—but they do make it clear that anyone hoping to achieve character outcomes from instruction will have to work for them and not expect them to come incidentally. Peters (229), in 1930, expressed the belief that history and geography offered excellent opportunities for incidental training in character; but three years later a study conducted under his supervision by Kniss, Robb, and Glatfelter (223) under actual schoolroom conditions showed that incidental instruction was "ineffectual in improving moral judgment and in furthering moral conduct." Sinclair and Tolman (233) found that instruction in science and mathematics did not lead to any decrease in prejudice or illogical thinking on citizenship or character questions.

Discussion method—The discussion method is one in which an attempt is made to improve attitudes and conduct by studying and talking about them. Many investigations have been made concerning the efficiency of this method, but the evidence is conflicting, particularly that dealing with the value of the method for improving actual conduct. Hartshorne and May (214) reported an experiment involving discussions of honesty. The instruction did not prove to be of any value in reducing dishonesty as measured by several conduct tests. In attempting to teach cooperation, however, these same experimenters found the method to yield some positive results. In Thompson's extensive study (236) he noted that a limited use of the discussion method led to improvement in honesty, but that, after a certain number of discussion periods, retrogression could be noticed. He found, for example, that children having 40 discussion periods improved appreciably less than those having 20. When applied to the teaching of attitudes and opinions, the discussion method is usually found to yield positive results, at least as judged by paper and pencil responses of the children taught. This was shown by the study of Campbell and Stover (207) on attitudes toward certain national groups and toward war; by that of Cherrington and Miller (208) on pacifism; and that of Robb and Faust (232) on ethical discrimination. The obvious question concerning all results involving changes in opinions and knowledge is the degree to which improvement in opinions and knowledge has any counterpart in improved conduct.

First-hand experiencing or project method—In contrast to the discussion method where emphasis is upon meeting character situations vicariously by talking about them, the project or activity method places the emphasis upon doing. A stimulating, non-experimental discussion of the possibilities of this method has been prepared by Bower (206).

In spite of the high favor in which this method is held by many educators, there has been little experimental work done to determine whether it is the activity alone or the activity plus discussion which really should be recommended. There is one study to report. Jones (220) has prepared a brief abstract of a lengthy study, not yet published, in which the first-hand experiencing method, the discussion method, and a combination method composed of both are compared. He found that experiencing without discussion and generalization often seems to be no better than discussion without first-hand experiencing. Doubtless the advocates of the activity method mean to include discussions along with activities, but often they fail to emphasize this fact. This study serves to stress the necessity of considering meanings and generalizations in all learning which is to have any transfer effects, and holds out the warning that if thought and discussion are omitted from activity programs in character education there is danger that they will eventuate in mere *doing* rather than in real educational *experiencing*.

Combination method—activity plus discussion—This method seems theoretically to be the most satisfactory one for general classroom use. It incorporates the principle of learning by doing and at the same time applies the transfer-of-training principle that whatever is to transfer must be "raised to the level of consciousness." It avoids the empty discussion of traits and the attendant danger, so properly condemned by the Department of Superintendence Yearbook (228:46), of leading children to become character-conscious or self-righteous. It is to be regretted that there is not more experimental evidence concerning the value of this method, but what is available is definitely in support of it. Collamore and Jones (210) reported in some detail a project in trusteeship in which the combined method was used, and from the description of the children's reactions during the unit it appears that improvements in moral behavior must have been taking place, though no quantitative results are given. In Jones' study (220) referred to above it was found that the activity-plus-discussion method was superior to activity or discussion taken singly. Zyve (247) has found that specific practice of honesty in scoring test papers when supplemented by discussions led to appreciable decrease in cheating in situations closely similar to those in which the training took place. She stressed the importance of specific practice and specific discussion as contrasted with non-specific practice and discussion.

Studies Bearing on Non-Classroom Methods

In addition to the possibilities for character education through planned instruction in the classroom there are also opportunities offered through athletics, through various group activities of the school, through cooperation with non-school agencies, and through the intangible force of the teacher's personality and character. With regard to athletics, the Department of Superintendence Yearbook (228) stressed the opportunities offered there for guidance in group loyalty, teamwork, and good sportsmanship. Sufficient attention, however, is not given to the win-at-any-cost attitude which dominates the methods of many coaches and physical directors. It is to be regretted that few experimental studies have been made to determine the actual character gains attending athletic programs. Clevett (209) obtained results in connection with physical education activities which indicate that if special effort is made, improvement in character can be achieved through such activities. Hackenberg, Yeich, and Weisenfluh (213), however, compared the athletes and non-athletes of three schools in certain character traits to which presumably athletics should have made some contribution, and in only one of the schools did they find the athletes to surpass the non-athletes.

The opportunities for character education through club activities both in and out of school are well presented in the Department of Superintendence Yearbook (228). Specific methods which have been employed in various cities for cooperation between the school and Scouts, Boys' Clubs of America, Camp Fire Girls, Junior Red Cross, etc., are described. Ways in which the school may cooperate with the home, the church, the child guidance clinic, and other agencies concerned with character education of children are worthy of much study.

There are many studies, however, showing the limitation of all work in character education if the cooperation of the home is not obtained. Work in the prevention and cure of delinquency and that in sex education are particularly contingent upon the favorable attitude and active cooperation of the home. Indeed with regard to sex education the Department of Superintendence Yearbook (228) took the position that though the schools can do something through the regular curriculum and through individual counseling, "many school systems will make their most significant approach through parent education." The following are a few of the significant studies and discussions emphasizing the necessity of considering the cooperation of the home in any plan of character education: Berk, Lane, and Tandy (204), Germane (212), Watson (241), and Williams (244). Witmer (245), however, showed the difficulty of making changes in parents' attitudes and methods by a parent-education program in sex education.

The last and most important factor of the school to be mentioned in connection with character education is the teacher. Wickman (243) showed that teachers differ greatly in their ability to distinguish between the trivial and the serious in misconduct, and also differ in their ability to see opportunities for character education with individuals and groups. Healy and Bronner (215) said that teachers' dislikes and prejudices help determine children's attitudes and behavior. From these and similar reports it appears that the most important single element in planning work in character education is the selection of teachers who are well adjusted, natively gifted, and well trained. Even with the best of programs and best of methods there will be between the superior and the inferior teacher a vast difference in the power to influence child conduct.

CHAPTER IV

English Language

This review of research in English at the elementary-school level summarizes the available objective evidence not covered in previous issues of the *Review of Educational Research,* with particular emphasis on the period from January 1, 1931 to July 1, 1934. Following the comprehensive summary of studies in language, grammar, and composition prepared by Lyman in 1928 a number of useful résumés of research in the field of English have been made available. In addition to those mentioned in Volume I of the *Review of Educational Research* (321, 366), there are three summaries which deserve mention. The National Conference on Research in Elementary School English (285) presented the results of a research program in a single institutional center. Through the same organization, Guiler and Betts (288) presented in 1934 a summary of thirty-five important research studies in elementary-school language. The Research Committee of the National Council of Teachers of English has also prepared a résumé and bibliography of research contributions to the teaching and curriculum making in English which have appeared in published form during the first six months of the current year. This summary is to appear in forthcoming issues of the *English Journal.*

The results presented in these summaries represent significant evidence of the rapidly increasing interest in research in language. The recent appointment last year of a Committee on Research by the National Council of Teachers of English and the organization of the National Conference on Research in Elementary School English are most encouraging signs of the increased consideration now being given to objective methods and evidence by those most interested in the improvement of instruction in English.

Research Technics

Two important types of research technics in English deserving mention have been developed during the period covered by this review. Betts (258) developed and evaluated apparatus for the electrical recording of oral language activities under experimental and classroom conditions. Under the conditions set up in this experiment the electrical recording apparatus proved to be distinctly superior to all other forms of recording such as court reporters, shorthand reporters, longhand reporters, and phoneticians. Experience with this apparatus indicates that it opens up great possibilities for curriculum investigation in language. Goldsmith (281), Goltry (282), Kiefer (314), Laughlin (319), and Nixon (328) used this equipment in securing extensive samplings of pupils' oral language activities at various grade levels. The apparatus which has been much refined is now in use in an extensive research program in oral language.

The mechanical analysis of oral and written language by means of Hollerith machine equipment has been successfully undertaken by Goltry (282). Goltry's study, at present incomplete, involves the analysis of over 100,000 running words of free oral language of pupils in grades four, five, and six. The transcriptions of the oral recordings of these samplings have been transferred in small units to Hollerith machine cards and by means of a system of coding the significant usages are identified. Coded samplings of oral and written language usages covering the entire grade range amounting to approximately one million running words are now ready for analysis.[1]

Content and Placement of the Curriculum

Research in the English curriculum is definitely influenced by the psychology and philosophy underlying language instruction. The objectives of the teaching of language, composition, and grammar have been precisely summarized in the report on English in the National Survey of Secondary Education. In this report D. V. Smith (348) revealed startling evidence indicating that English teachers are far too much occupied with the mechanical and technical aspects of language. Greater need for emphasis on oral language has been presented by Lyman (326) and others. Starbird, Williams, and Hatfield (354), in a report of the Research Committee of the Greater Chicago English Club showed that only one out of twenty-nine social demands on language ability was of the written type.

Studies in the content and placement of instructional units in the language curriculum approach the problem from a number of different points of view. Hays (303) analyzed seven series of elementary English textbooks for the purpose of determining the mechanical and usage skills receiving emphasis, and the grade location of each. R. A. Bailey (252) checked three ninth-grade English texts and found that far too much emphasis was given to instruction on mechanics and not enough to oral language and the ability to express ideas clearly. Lien (324) checked the amount of drill on adjectives, the number of different adjectives receiving emphasis, the grade placement, the presence of supplementary drill, and the social importance of the adjectives used in six modern elementary language textbooks. Van Brussel (362) made a similar study of verbs not previously reported.

As a basis for the more exact allocation of language skills in the lower elementary grades, Brainard (262) and Friest (277) attempted to identity pre-third-grade skills. Brainard asked superior first- and second-grade teachers in five hundred schools in the forty-eight states to check: (a) the skills taught because required by textbook or course of study; (b) the skills taught without regard to requirements; and (c) skills which they expected a child to know on entering the grade. Friest checked courses of study, textbooks, and workbooks with a similar purpose in mind. The results of the two studies reveal a surprisingly large list of pre-third-grade language skills.

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[1] A study by H. A. Greene, University of Iowa. Incomplete and unpublished.

In keeping with the more modern concept of social usage as the basis for the curriculum, the analysis of the writings of children and adults naturally affords the most effective source. C. H. Bailey (251) analyzed the written compositions of 1,150 pupils in grades four, five, and six for verb forms and verb errors. The error frequencies and quotients for these verb forms afford a very useful source of drill material. Holtman (305) cross-checked pupil usages of pronouns in their compositions with instruction given on these items in textbooks. Frogner (279) analyzed the punctuation of approximately 1,000 pupils in grades seven, nine, and eleven for evidence on practical aspects of the teaching of sentence structure.

Nice (327) studied the development of sentence sense in children from sixteen to forty-three months. Hoppes (306, 307) reported significant growth in written expression of elementary-school children in grades three, four, five, and six in respect to mastery of gross elements of sentence structure and apprehension of word meaning. Seegars (344) found a definite relationship between the form of the discourse and the complexity of sentence structure used.

Test results have been critically analyzed by Guiler (289, 295) and by Lawrence (320) to secure a basis for the more efficient correction of persisting errors in usage. Guiler (289) tabulated the difficulties in the use of verb forms in the Guiler-Henry test encountered by 625 college freshmen. Tests papers of 38,529 Ohio school children in grades three to six were also analyzed by Guiler (295) to reveal the prevalent types of errors. Lawrence (320) gave an informal test of fifty sentences in multiple choice form to one hundred eighth-grade students in English classes. Boys consistently made many more errors than girls. A useful frequency list of the fifty errors used in the study was reported.

La Brant (317) showed certain characteristic language developments in children in grades four to twelve by analyzing approximately 1,000 compositions. Bardwell (253) reported the results of a survey of pupils in all elementary schools in Madison, Wisconsin, showing a useful list of language faults with their frequencies. Pease (333) analyzed 480 compositions written in school by pupils of grades seven to twelve for the purpose of revealing grammar usages and errors in these grades. Landsdowne (318), in attempting to find a remedy for unsatisfactory results in grammar teaching, studied the grade placement of the elements of formal grammar in twenty-five public school systems. Crowding and inconsistency were apparent throughout. The thorough teaching of a few items of formal grammar related to usage chiefly through the sentence comprises the major recommendation of the study. Current researches dealing with the selection and grade placement of grammar items were analyzed by J. P. Leonard (322). A definite allocation of functional grammar items is presented for each of the four high-school years.

Klein (315) found that fifth-grade students whose intelligence is high tend to use specific, vivid, and accurate adjectives. Benzler (257) analyzed the compositions of fourth- and fifth-grade pupils to reveal differences in the mastery of certain punctuation skills by high and low I.Q. groups. A similar study by Vanderstoep (363) was carried on in the sixth grade. Significant differences in the error quotients for the two groups are reported in both studies.

Oral language activities have been recorded and analyzed by Goltry (282), Goldsmith (281), Laughlin (319), and Nixon (328). The last three studies deal with the oral language usage of children in the primary grades, and present evidence on pupil mastery of modifiers, verbs, and sentence structure. Kiefer (314) made a significant contribution through the electrical recording and analysis of oral summaries representing a year's work in a first grade. Kiesling's study, now in progress at the University of Iowa, analyzed these same data in an attempt to reveal objectively certain characteristics accounting for high and low quality in oral compositions.

The relation of oral and written language activities has been shown objectively by three studies based upon the same data collected by means of the electrical recording equipment. Gregerson (286) showed relatively low correlations for the quality of oral and written compositions prepared by the same individuals. However, there was the expected superiority of the written composition over the oral in each class in which the study was made. Jakeman (309) analyzed the same transcripts for differences in oral and written vocabulary forms. White (365) further refined the data to reveal differences in the semantic variations in vocabulary used in written and oral compositions.

Objective evidence on the grade placement of language items is very limited, and such as is available is indirect. Cockerill (265), B. N. Hamilton (298), and F. N. Hamilton (299) carried through studies of pupil usage of certain punctuation items in grades five, seven, and nine as factors in grade placement. These studies were based upon the same data used by Cesander (264) in grades four, six, and eight. Other indirect evidence of some assistance in determining grade placement is that prepared by Gettys (280) and Kennedy (313). The former study deals with persistence of error in certain of the basic punctuation usages while the latter deals in a similar way with persistence of error in pupils' reactions to certain common verb forms. O'Rourke (330), in a summary of evidence collected in connection with a nationwide survey of language usage, presented a real challenge to teachers of English. Slight positive increases in mastery of certain common usages were revealed from grade to grade. On the other hand, many simple usages failed to show mastery even at the end of the senior year of high school.

Difficulties in the establishment of standards or criteria of usage have seriously handicapped curriculum construction in language. S. A. Leonard's monograph (323) brought together a large amount of evidence on certain current usages. Pooley (335) revealed many of the discrepancies in grammatical rules on the one hand and conventional usages on the other as they have come down through a century of language growth. Barnes (255), working with a committee of students, showed most interesting evidence on certain disputable items in the Leonard monograph as checked against such authorities as Fowler and Krapp. Over 400 slang terms were also rated for 100 men and women. This study also reported the results of checking twenty-two standarized tests in English for the presence of disputable items appearing in the Leonard monograph. The judgment of 121 radio announcers and officials was also secured on the selected usages. In general, radio announcers and executives were found to be conservative, while eminent linguists were much more liberal in their approval of questionable usages. More than one-third of the slang expressions were considered as acceptable. Standardized tests were found to be very conservative in their willingness to discard commonly accepted errors.

Greene (283) proposed as a criterion of correctness in certain mechanical abilities in written language the frequencies with which each specified usage is mentioned in seven manuals of style used by twenty-six publishing houses. Obviously such a criterion has many limitations. Betts (259) presented further evidence on the utility and limitations of this procedure. Njus (329) prepared a similar type of standard of correct language usages by cross-checking ten handbooks and style manuals on usage and diction. Bontrager (260) made an analysis of the criterion proposed by Greene showing the vocabulary content, the main ideas involved, and the precise variations in the important punctuation situations presented. Four hundred eighty-four specific variations of punctuation skills were identified of which forty-four were tested objectively for mastery. This study showed the need for a much more complete check of the various language skills as used by pupils and by adults if we are to discover which variations of skills actually carry the load in social usage.

Evaluation of Method

Warner and Guiler (364), using 360 ninth- and tenth-grade pupils arranged in three equal groups, conducted an experimental evaluation of individual instruction versus group instruction. This experiment extended over a period of twelve class periods of fifty-five minutes each. The results indicate that individual instruction based on individual diagnosis is much more effective than mass instruction in the correction of shortcomings in grammatical usage. Allen and Murphy (248) proposed a practical combination of the individual and group methods of instruction. Experimental evidence supporting the plan is not presented, although specific claims are made for the efficiency of the plan.

The effect on accomplishment in English of varying the length of a study period was investigated by Boynton and Barnard (261) in a ninth-grade class of twenty students. While the population used in the investigation was doubtless inadequate, the evidence nevertheless raises some question as to the efficiency of the shorter study period which is quite commonly accepted. The problem of establishing the optimum length of study period under classroom conditions seems to have been reopened by this study. Dalthorp (268) found little or no difference in the efficiency of instruction resulting from teaching English to twelfth-grade students in groups of eleven and of thirty-nine. While the smaller group naturally received more individual attention, there was greater stimulation for the teacher in the larger group resulting in more alertness on the part of the pupils.

Hatfield (301) compared the results of dogmatic and inductive procedures in the teaching of rules and general principles to a seventh-grade class. Two classes were studied, one being considerably better than the other. The same grammatical principles were taught to each class. The results seem to indicate that the inductive presentation is more desirable for bright classes, while the dogmatic presentation is better for slower pupils. The inadequate number of cases used in the study and the lack of control over the quality of pupils and ability of teachers condition somewhat the general acceptance of this conclusion. Eurich (272), working with 169 university freshman students in an experimental group and 233 students of a similar type in the control group, evaluated the vocabulary growth of these students during an academic year. Marked improvement in vocabulary mastery was shown by the experimental group.

The relation of mastery of a usage to a knowledge of a rule covering it was shown in studies by Ortmeyer (331) and Qualley (339). Both studies dealt with instruction in punctuation and revealed the fact that there is little transfer from knowledge of a punctuation rule to the correct use of the skills covered by it.

Tangible evidence of the efficiency of using the group summary as a technic for teaching language in the first grade was offered by Kiefer (314). In this investigation she recorded eighteen summary lessons in first-grade language scattered over a year's work. The specific purpose was to secure verbatim records of these lessons as they were developed as a basis for their later analysis. The improvement in the ability of first-grade youngsters to produce individual summaries of the oral type and to participate in the preparation of the composition group summary was very marked. Kiesling, in a study in progress at the University of Iowa, analyzed these same data by means of certain objective criteria and the supplemental use of an oral language scale. Among the more apparent factors affecting quality in these first-grade compositions was conciseness of vocabulary choice and exactness in expression of an idea. Length of compositions in terms of number of words was found to be of little or no value as a criterion of quality.

Remedial Instruction

Studies by Guiler (292, 294), at both the elementary-school and college freshman level, showed very clearly the possibility of improving pupil mastery of the mechanical and usage skills in language through remedial instruction. Guiler (291) also reported an experiment involving a limited number of cases in the improvement of ability in pronoun usage in a ninth-grade class. Marked improvement was shown when the difficult principles were discovered for the pupil and suitable practice materials were provided. Gunn (296) reported the beneficial effect of a weekly drill period of twenty-five minutes in reading, vocabulary, and English mechanics on the test scores made on standardized tests by high-school pupils. Keener and Rowe (311), working with third-grade pupils, found that a signficant improvement resulted from the use of practice materials. Variables were carefully controlled throughout the experiment, although the number of cases upon which the conclusions are based is quite limited. Esslinger (271) showed the favorable influence of the use of a specific type of language drill material when used under typical classroom conditions. Quam (340) also reported the effective use of drills in the elimination of certain common punctuation errors.

Price (338) experimented with university students to discover whether remedial work in English should be given during the second or third year. In general he found that a better class attitude existed toward the remedial work among the more advanced students.

Measurement of Achievement

Studies of testing technics point the way to definite improvement in the construction of language test items. Haworth (302) constructed two types of test items of the same language usage content. One set of items was stated in a form to be recognized and corrected by the student; the other in alternate response form. No significant difference in the validity or objectivity of the test items was found. There were only slight differences in time consumed in the administration or correction of the test. However, from the standpoint of reliability the data showed a significant superiority for the correction form of the item. Stickney (357), in a similar type of study, showed evidence that the recognition-correction type of exercise was equally valid, slightly more reliable, and a great deal more economical from the standpoint of student and teacher time than the multiple choice form over the same material. Reno (342) compared results from a proofreading English Mechanics test and the Columbia Research Bureau English Test. According to his findings the proofreading type of test was slightly superior to the recognition test for the measurement of the same abilities. Kline (316) compared three types of forms of test items covering the same material. The results of his investigation support the conclusions of the previous studies. Powell (336) checked nine themes for each of 302 ninth-grade pupils for the purpose of determining the efficiency of the error count in pupils' free writing, the error quotient, and an error analysis of performance on a long proofreading test. His data reveal a high correlation between error count and the error quotient procedure. However, the error count procedure is open to a number of very serious objections which practically invalidate it for classroom use.

Dolch (270) carried on an experiment in the measurement of word difficulty with forty children in grade six. Seventy words were presented to these pupils in columns with instructions that they were to mark with a zero all words which they did not know at all and with a question mark the words about which they were uncertain. Immediately after this, the seventy words were presented in a multiple choice form. Dolch concluded that multiple choice caught some of the guessing, but due to the fact that the multiple choice technic utilizes many wrong suggestions, it was impossible to discover precisely the extent of the pupils' word knowledge. In his opinion objective tests often fail entirely to show the true relative difficulty of words.

Kelley (312) experimented with a large group of pupils in grades five and six using five methods of testing word meanings. The pupil's ability to use the word correctly in a sentence was assumed as evidence of his knowledge of word meaning. Kelley concluded that the same-opposite-neither and multiple choice sentence tests were slightly lower in validity than the other types. The matching and multiple choice tests correlated most highly with the criterion. There was no improvement in the reliability and validity and little or no difference in the difficulty of multiple choice items in which the wrong responses were suggested by the examiner and those in which the students' own wrong responses to recall items were used. The multiple choice test form was found to be approximately twenty percent greater in difficulty than the multiple choice sentence test. According to Kelley, no one of the testing technics used proved adequate for use in the measurement of individual pupils.

CHAPTER V

Fine Arts

Methods of Teaching and Recent Trends

Few outstanding studies concerning methods of teaching art on high-school and college levels have appeared recently, although articles of a generalized and less scientific nature are numerous. Much of the research on the teaching of art in high schools and colleges can hardly be called scientific because of the lack of proper control groups or inadequate number of subjects for the types of tests used.

Several studies dealing with recent trends in art education have been made. Smith (415) and Whitford (425, 426), in summaries of trends in art education, reported that in the past decade the development of good taste and the creating of beauty in one's environment have become major objectives in the teaching of art; free expression is being encouraged, and the application of art in daily life stressed. Less formal and more creative activities are replacing former methods, the validity of which is beginning to be questioned by art teachers.

Hilpert (394) analyzed art courses in the public schools of forty-two cities (thirty-five of which were actually visited) in twenty-two states. He found that the subjectmatter was often unrelated to general objectives in the art courses, that little or no attempt was being made to allocate levels of art work to grade level, and that practically no attention was paid to group or individual differences.

Bird (370) suggested a new approach to the teaching of drawing in which observation and communication are stressed rather than imitation.

Crowley (378), in checking the effectiveness of five methods of teaching design on five groups of 680 high-school freshmen, found the direct observational method most effective. The "free interpretation" method proved very inferior.

Ulp (419) reported an experiment on the use of motion picture models on three groups of college art students. One group was composed of freshmen who had never drawn from life; a second group had had limited experience in sketch class; and a third group had had considerable experience. The freshmen, after two semesters, showed more improvement than the other two groups which had been trained with posed models. The lack of a control group lessens the value of the study somewhat, but this type of instruction may prove valuable and should be studied at greater length.

In studying the preferences of art materials and subjectmatter of 697 junior high-school students, Traill and Harap (418) found that painting and drawing ranked first as art process preferences, animals and landscapes as subject preferences, and pencil and crayon as art mediums.

Influence of Training on Art Ability at High-School and College Levels

A number of studies showing the influence of training on art ability have been made. Since there are apparently some conflicting results among the different studies, this phase of art education should be studied further. Several of these studies are of special interest to those wishing to do further work on methods of teaching, since many results seem to indicate a gradual maturation of the art ability.

Carroll (374) found that training in art appeared to have little effect on the test scores and that in administering tests for art ability to college art majors there was a correlation of only .15 ± .07 between the art instructor's judgments of creative ability and the McAdory Art Test, and a correlation of .40 ± .06 between ratings of art instructors and the Meier-Seashore Test.

Lewerenz (400), testing forty-two high-school pupils electing an art course, found a correlation of .63 between test scores and the teacher's estimate of class work extending over a period of five months.

In a study of the effect of elementary and secondary public school art on the judgment of 481 pupils when considering problems of art in everyday life, Weldele (423) found the mean for city school pupils to be higher than for rural school pupils. No difference in scores was shown to be caused by chronological age, and the mean for pupils who had attended art exhibits was 12.85 higher than for those who had attended none. The author concluded that training in art is necessary for the average person to be able to appreciate art as it appears in everyday life.

Other investigators disagree in the matter of necessity of training in art judgment at high-school and college levels. Zinn (430), in a series of tests given to 1,116 public school children and 100 college students, indicated that maturity and experience aid originality in art and that originality seems to be a special skill.

Likewise, Wall (420) concluded from questionnaires concerning art, literature, music, and related subjects as answered by 758 school children from eight to sixteen years, that apparently esthetic taste is native and universal and that there appear to be three clearly separated stages in esthetic development, which seem to fall into the following age groups: 0-8 years; 8-12 years; 12-16 years. The conclusion of universality here does not seem to be warranted on the basis of these data; the arbitrary age groupings should also be given further study.

Williams (428) reported from a study of the sensitivity to color harmony of 600 children and adults a definite relationship between chronological age and test scores. A "leveling off" seems to occur at about the twelfth year.

Miller (408), however, carried out an experiment to determine the effect of isolated form on 1,014 junior high-school students. Age apparently has little to do with this type of esthetic judgment.

One thousand and thirty-one children with chronological ages between six and sixteen and mental ages between five and fifteen years were tested by Baron (369) for color discrimination. There appears to be no relationship between ability to discriminate colors and mental age, but a marked relationship between ability to match shades of the four fundamental colors and the mental age.

Shaffer (413) studied the interpretations of cartoons by approximately 2,700 children from grades four through twelve. The correlations of scores on the individual cartoons with mental age was .285 for grades four through six; .295 for grades seven through nine; and .242 for grades ten through twelve. Apparently the relationship between mental age and cartoon interpretation is low; but there appears to be a maturing of the ability to interpret cartoons which is proportional with mental age.

Research in Related Fields

Studies of the relationship of art ability to certain personality traits popularly called "artistic temperament" should be of value to teachers of art.

Carroll (373) reported no significant relationship between art ability as measured by the Meier-Seashore and McAdory tests, and personality traits as measured by the Bernreuter personality test, on a group of one hundred university students. No relationship was found between art and introversion, or emotional instability.

Carroll (372) also found from a study of ninety art students and forty-three non-art students of college level that the interrelationship existing among the capacities to appreciate art, literature, and music was very slight. Art and literature appeared to vary together more than art and music.

Hayden (392), Whitford (424), and Tannahill and Kurzband (417) have compiled bibliographies in the field of art education which will be helpful to workers carrying out further research in this field.

CHAPTER VI

Health and Physical Education

Definition and Limitation of the Field

THE boundaries of health education and physical education do not coincide. The two fields have an area in common, but they also have areas peculiar to each. Both are concerned with the making of desirable physical and psychological changes in individuals.

Descriptions and evaluations of health programs in city (435), county (431), state (432, 450), and rural districts (444) furnish a useful background against which to study special methods and relationships, since all aspects of the health program are inextricably interrelated. There are trends toward a more constructive and adequate program for all pupils, not only for the health deviates; toward instruction that stresses healthful living; and toward physical education that furthers the health, social efficiency, and culture of all pupils rather than cultivates intensively the athletic proficiency of the few. Investigations relating to programs and objectives of health and physical education have recently been summarized by Wood and Mealey (456).

Space does not permit the inclusion of other references, useful in giving a background in the field, such as the preliminary report of the Committee on Professional Ethics in Health and Physical Education (455); the history of health and physical education (448); the personnel for teaching health (446); and the relation of physical education to the health aim (451). This section is limited to investigations of the psychology and pedagogy of health and physical education in the elementary school.

Diagnosis and Individual Health Needs

The diagnosis of the health needs, capacities, and interests of individual children is prerequisite to health instruction. Brouillette (457) summarized previous surveys of physical deviates and reported the results of a medical examination of 2,262 elementary-school children. Of the thirteen kinds of defects studied the most prevalent were: defective tonsils (found among 72 percent of the children); defective teeth (58 percent); anemia (38 percent); intestinal parasites (36 percent); and malnutrition (21 percent). The percents of defect in this community differed considerably from the percents reported in other surveys and indicated the need of a health program adapted to the local community and of the better standardization of physical and medical examinations.

Cumulative record—One important instrument of diagnosis is the cumulative record. Hamer (458) constructed two types of cumulative record cards based on a study of about seventy-five records in use in high schools. These records included information concerning the results of medical examinations, requirement fulfilments, attendance, and marks. These records were based largely on present practice. An evaluation of their usefulness in the development and guidance of individual pupils is still to be made.

The Learning Process

Little scientific work has been done during the past four years on the analysis of the learning process and on the nature of the mental operations involved in health and physical education. Most of the investigations have been merely exploratory.

Repetition of factual information—Pettit (519) found a repetition of many health topics common to each of the five series of texts analyzed. She proposed an experiment to ascertain the value of repetition in the teaching of hygiene. The optimum number of repetitions of health facts, time intervals between repetitions, and duration of learning periods should be studied.

Skill in sports—Miles has done outstanding work in the psychological analysis of certain athletic skills. He studied the individual and group reaction time in football charging (462), the effect of signal variation on football charging (461), and other phases of athletic skills. His work serves as an admirable model for other investigators. Aycock, Graaff, and Tuttle (459) sought to analyze one aspect of skill in swimming by studying the respiratory habits of trained swimmers. Griffith studied the factor of timing (460), made an analysis of types of errors in free throws (514), and studied the process of learning to drive a golf ball (513).

Learning a rhythmic pattern—Muzzey (463) studied the differences between a group of fifty white children and a group of fifty colored children, in grades two to six, in learning to respond to a typical rhythm. She used an electrical apparatus devised to record objectively movements of the large muscles. In all twenty-four trials the colored children made a larger average number of correct responses than did the white children, although the latter had had superior musical and rhythmic training. The colored children were not only superior to the white children in initial rhythmic ability, but also in rate of initial learning. The white children were less variable in their performance and made more steady progress in learning than did the colored group.

Relationships between Health, Motor Ability, and Other Factors

A study of the relationships among various factors involved in the process of health and physical education is useful in understanding the nature of the task. Relationships in physical and mental development have already been summarized (470). A few other relationships will be reviewed in this section.

Physical defects and other factors—McCollom (473) found that gains in height and endurance of 104 junior and senior high-school boys were associated with correction of kyphosis, lordosis, scoliosis, and flat feet, but increase in weight, chest expansion and capacity, and strength did not consistently accompany improvement of these four physical defects. The highest percent of improvement was made in the groups of lower intelligence and during the period of most rapid growth, namely, from fifteen to sixteen years of age. The author pointed out the need of more accurate and reliable measures and a study of a larger number of cases in each age group.

Maller (474) obtained a correlation of —.36 between incidences of defect of eyes, teeth, tonsils, and nutrition, and intelligence quotients of about 10,000 fifth-grade pupils in New York City schools. Even when social-economic status was held constant, the correlation between intelligence and health remained significant. Richey (476) compared retests of intelligence of 104 children who had had tonsillectomy and adenectomy performed in the interval between testing with similar retests of 100 children whose health reports indicated diseased tonsils or adenoids but who had not had these conditions corrected. This investigation, like others of a similar nature, failed to reveal any reliably significant changes in intelligence which could be attributed to a diseased condition of the tonsils and adenoids or to their removal.

In an extensive economic and health survey (480) in New York City a direct relation was found between nutrition and income. Of the children from the lowest income groups, 40 percent were rated "poor" or "very poor" in nutritional status as compared with 25 percent of the children from the higher income groups. Lininger (472) found that the pupils using milk at home and at school gained 45 percent more in weight, during a period of two years, than did those not using milk. The amount of milk consumed was found to be associated with the economic status of the families.

Motor ability and athletic skills—Data for 333 girls in two vocational high schools showed a low but significant negative correlation between scores on the Brace Scale of Motor Ability and the Pressey Senior Classification Test (475).

DiGiovanna (467) obtained evidence in support of the belief that posture and the ability to achieve in athletics are positively related. In his group of 123 boys in Athletic Class II, good posture was associated with somewhat superior achievement in every event except the basketball throw for goals. Taylor (479) studied the relationship between kinesthetic judgment and success in basketball playing. He selected from among fourteen tests of kinesthetic sensitivity six that showed correlations (special form of biserial r) of .40 or higher with success in basketball.

Physiological functions—Wells (481) reviewed the literature and reported the results of an original experiment on the effect of external temperature changes on certain physiological functions. F. L. Harmon (468), in a carefully controlled laboratory experiment using two subjects, found that mental work is accompanied by small but consistent increases in metabolic rate, heart rate, and breathing rate and volume. Noise further increases these processes at first and puts a tax upon the organism during the period of adaptation. Leal (471), in investigating a situation involving 2,143 girls in grades four through twelve, found that girls maturing early tend to be taller than do those of the same age maturing later. The greatest variability was in ages eleven, twelve, and thirteen.

Tests and Measurements and Related Studies

Instruments of measurements are essential in the study of individual differences in health status and behavior and in the diagnosis of health needs and capacities. Bovard and Cozens (483) described and discussed the various types and practical uses of tests and measurements in physical education. They included chapters on anthropometric measurements; strength tests; cardiac functional tests; athletic ability and achievement tests for elementary school, high school, and college; neuromuscular control tests and indexes, and sport technic tests.

Measurements of growth and physical conditions—Increased interest in new methods of measuring the growth and nutritional condition of children followed the publications of the School Health Research Monographs of the American Child Health Association. Boas (482) stressed the importance of cumulative growth records of individual children. Miles (495) described the construction and use of a caliper for measuring skeletal diameters. Lucas and Pryor (494) reported work on the body measurements of 1,000 children in their effort to secure a simple and reliable index of nutritional condition. Shelton (503), from previous measurements, prepared a more practical and modern set of tables and roentgenograms of the normal osseous development of children from birth to twenty years of age. Lincoln (493) used two groups of about 100 seventh-grade pupils to test the reliability of eighteen anthropometric measures. These measurements made under ordinary school conditions proved highly unreliable. Even with an improved technic, perfect reliability was not secured.

Clarke (488) described an objective, fairly reliable method of measuring the longitudinal arch of the foot. The method of X-raying 6,000 children in New Haven seems expeditious, inexpensive, and effective in tuberculosis prevention (496). New paper films costing sixty cents per child for X-ray and development were used.

Measurements of athletic ability and achievement—Purcell (500) sought to determine the relative classification value of fifteen tests of athletic ability in sports and games by correlating each test with the summation of scores of the fifteen tests. He suggested the following tests as best for classification purposes: the 100-yard dash, the broad jump, the high jump, and the medicine ball put; the push-ups, the rope climb, and chinning; the baseball accuracy, the dribble-in-tap shots, and the Burpee. Rodgers and Heath (501) reported on the semi-experimental use of knowledge and skill tests in playground baseball, and Edgren (489) on similar work in basketball.

Ratings—O'Neel (497) constructed a scale for the measurement of certain personality trait reactions in high-school physical education classes. The self-correlations between the two groups of student judges was extremely low, due, in part, to the lack of suitability, specificity, and concreteness in the items on the scale and to inadequate training of the judges. Snyder (504) suggested eight items for rating health practices, four of which emphasize accurate observation of overt behavior.

Questionnaires—Over a period of six years Seham and Schey (502) developed a health habit questionnaire and a health efficiency questionnaire which are "reasonably reliable and valid." These questionnaires should prove of decided value in the diagnosis of health habits and mild functional disorders of children.

Methods of Teaching Health and Physical Education

Teaching health—A few experimental investigations of different methods of health education have been attempted. Osborn (518) equated one experimental and five control groups of children in the fifth grade on the basis of initial scores on the Gates-Strang Health Knowledge Test, chronological age, and educational quotient. She measured progress in terms of health information, habits of cleanliness, and health interests. The children of the experimental group used an activity program consisting of the following features: checking on nine habits of personal cleanliness, observation by the teacher of the needs of each child and planned instruction in accordance with the individual needs, committee reports by groups of children, and individual reports of progress in the formation of health habits. In the control groups various conventional methods of instruction then in force in the schools were used. Each of the six groups made gains in health knowledge during the experiment. The experimental group showed a consistent, though not statistically significant gain, over the control groups. Schwieg (523) described a less carefully controlled experiment in which the many interesting health activities of the experimental group aroused general interest in health knowledge and practice throughout the entire school.

A larger number of descriptions of methods of teaching health are to be found in the literature. For example, McCormick (516) and Sorenson (524) discussed in a helpful way the use of natural life situations in the building of health habits. Pinckney, Miller, and Pettus (520) have written a practical, concrete, and valuable guide for elementary-school teachers based on their experience with school health work in Texas.

Visual aids—The first step in studying the effectiveness of visual aid in health education is to list, describe, and evaluate theoretically the various kinds of visual instruction as they apply to health education. This, Conrad (510) has done. In his list are included blackboard illustrations and teaching devices, films, charts, posters, classroom specimens, and class excursions. The next step is to study experimentally each of these aids in health education.

Teaching athletic skills—More adequately controlled experiments on methods of teaching skills are needed. Cozens (511) found improvement in certain types of track and field events more marked when the practice periods were spread over a considerable duration of time than when practice was concentrated. In dart throwing, however, Luh and Liang (515) secured the highest efficiency after the fifth and sixth hours of twelve hours' continuous throwing. The middle third of this long practice period was the most efficient and the last third, least efficient. Schnitman's description (522) of a mass drill which seemed to give excellent grounding in the fundamental skills of basketball and Olander's description (517) of methods of teaching football skills are two examples of many articles describing methods of teaching various athletic skills.

Next Steps Needed in Research

Sufficient surveys of health and physical education in elementary schools have been made to reveal the inadequacies of present programs. There is need of genetic studies of the development of healthful behavior in children. Case studies of individual children should be made over a period of years showing changes in physical conditions and habits, knowledge, and attitudes relating to health. Not only the end results but also the process of learning should be studied in order to ascertain the conditions favorable to the building up of habits of living that will aid the optimum functioning of each individual.

Suggestions for research in this field have been made by Griffith (527), Williams (529), and Browne (526). A program of research in this field might well include the following features:

1. Continuous critical descriptive records of the development of programs of health and physical education in selected schools.
2. Continuous study of pupils as suggested above.
3. Intensive studies of relationships among factors such as health and scholarship, health and conduct, health habits and health knowledge, etc.
4. Experimental situations in which the outcomes of certain changes in procedures are recorded.
5. Controlled classroom experiments in which the results of different methods and materials are compared.
6. Controlled analytical laboratory experiments which furnish accurate facts on specific questions and suggest leads for classroom procedures.

CHAPTER VII

Reading

THIS section summarizes the contributions of 83 scientific studies to the psychology and methods of teaching reading in elementary schools. The plan adopted in preparing the summary differs somewhat from the usual procedure. The bibliographies prepared annually by the writer covering the period from July 1, 1931, to June 30, 1934, were first checked by Doctors Gates, Horn, and Yoakam for completeness. Any omitted published studies were added to the list. It is only fair to say that many important unpublished studies were omitted. The cooperators next checked all references which in their judgment contributed to an understanding of the psychology and methods of teaching reading in elementary schools. The checked lists were then compared and all references reviewed which had been checked by two or more members of the group. A summary was next prepared in preliminary form and submitted to the cooperating experts for criticism and suggested revisions. These suggestions were then assembled by Doctor Gates and the revised copy returned to the writer for approval or further changes. On account of the limited space available, it was impossible to include many personal interpretations of the results of the studies or criticisms of the technics employed.

Successive Emphases in Method

Throughout the history of American education, one major emphasis has succeeded another in teaching reading, as shown clearly by N. B. Smith (608). For example, during the colonial period, oral reading and memorization were emphasized vigorously. During the post-revolutionary period, major emphasis was given to elocutionary delivery and to correct pronunciation and enunciation. During the middle half of the nineteenth century, the word method was substituted for the alphabet method. Before the end of the century, the sentence and story methods, on the one hand, and the phonic and phonetic methods, on the other hand, received large emphasis in many schools. From 1880 to 1915, the literary ideal dominated reading instruction. In this connection, large use was made of new technics to awaken interest in and to arouse appreciation of literature. More recently, chief attention has been given to the improvement of silent reading. This has resulted in the development and use of numerous technics and procedures to promote growth in habits of intelligent silent reading and to stimulate interest in and motives for independent reading. One of the lessons which these facts teach is that the methods and content of teaching are influenced to a greater or less extent by changing educational objectives.

Systematic versus Incidental Training in Reading

In attempting to determine whether regular reading periods should be retained in the daily program of elementary schools, Bonar (542) summarized various studies and reports concerning the relative merits of incidental and systematic training in reading. The facts presented showed that both types of training have value; they also justified the conclusion that there is a distinct place for systematic training in reading at the elementary-school level.

Reading Readiness

The importance of appropriate training and experience before pupils learn to read has been emphasized repeatedly during recent years. In an effort to determine limitations in the child's previous experience, Waters (615) prepared a list of concepts or experiences required to interpret the material in fifty available primers and first readers. She then examined thirty-one kindergarten children to find out which of these necessary experiences were lacking. Those most lacking related to birds, the zoo, the seashore, the circus, and picnics. It is obvious that different results might have been secured in other kindergartens. Waters next reorganized the kindergarten program in order better to supply the needed experiences. Similar steps were recommended in the case of each beginning class.

Lee, Clark, and Lee (579) supplied additional evidence of the validity of the reading-readiness concept, as well as of their own "reading-readiness test," by correlating the scores on the Lee-Clark Reading Readiness Test given to entering first-grade pupils in seven schools with the scores on reading tests given at the end of the first and second semester. The correlation between two types of scores was .54 in the case of the Gates Silent Reading Tests, Types 1, 2, and 3; and .68 in the case of the Lee-Clark Reading Test. These correlations were much higher on the average than those between success in reading and ranks on a kindergarten rating scale or teachers' estimates.

Much interest has been expressed recently concerning the optimum mental age at which children should learn to read. In a study of bright, average, and dull children at the four-year mental level, Davidson (552) found that bright, average, and dull children with mental ages of four did not learn to read equally well under the same experimental conditions. The bright three-year-old children with mental ages of four were superior to the average four-year-old and the dull five-year-old children. These findings suggest that a mental age of six and one-half years may, as some writers maintain, not be necessary in order for bright children to learn to read effectively. Davidson's conclusion to the effect that some children of a mental age of four can "learn to read in a manner comparable with the success of average first-grade children," doubtless has some validity but is not directly supported by the evidence presented in the report.

Merits of Different Methods of Beginning Reading

Keen interest continues among school officers and teachers in the relative merits of different methods of teaching beginning reading. For example, Bergman and Vreeland (540) compared the progress of first-grade pupils taught through the use of the Picture-Story Reading Lessons and a visual method, so called from its wide use of stereographs and the stereopticon. The two methods which aim at widely different results are similar in that each endeavors to develop a well-selected vocabulary at the end of the first semester. The tests of word recognition used indicated that the Picture-Story Method was the more effective. As pointed out by the experimenters, other measures of progress are essential before final conclusions can be drawn. Gatto (562) also reported the results of a study in twenty-one Pittsburgh schools to determine the relative effectiveness in the grade 1B of two reading systems, the names of which were not given. They had been ranked about equally high by the textbook committee. Conclusions were based on the progress made by the pupils and on the teachers' ratings of the two systems. The teachers' ratings and the test results both indicated a slight superiority of one system over the other.

Value of Printing, Cursive Writing, and Manuscript Writing in Teaching Beginning Reading

With the introduction of manuscript writing, renewed interest has been expressed in the type of writing that can be used to greatest advantage in teaching beginning reading. Long and Mayer (582) compared the progress of two groups of 500 children each taught to read through the use of print and cursive writing respectively. The former proved much more effective in teaching pupils to read print. No study was made of the effect of the use of the two methods on reading script or in learning to write. Voorhis (614) compared the relative merits of cursive and manuscript writing in first-grade classes. All the evidence secured indicated the superiority of the latter, both in teaching reading and as a form of writing for primary pupils.

Size of Type and Readability

Buckingham (545) carried on an elaborate experiment to determine whether first-grade pupils can read 12-point type more easily than they read 14-, 18-, and 24-point type. Simple material was printed in these various types with the same and with different leadings. The relative efficiency of the various types was measured in terms of rate of reading. The rank order of the type as determined by the records secured was 12-point, 18-point, 24-point, 14-point. The natural inference from this finding would be that 12-point type could be used in first-grade books to distinct advantage. This experiment is open to pointed criticisms. It fails to consider many very important criteria such as eye-strain. The findings are not in harmony with those of previous investigators; furthermore the rank order of the type as reported above suggests chance variations. Further experimental study is essential before radical changes in the size of type used in beginning reading books are justified.

Methods of Attacking Words in Primary Reading

The methods by which pupils attack words were studied by Wilson (616). She identified the following technics among twenty second-grade pupils: "intelligent guessing of words from the context or thought"; "met new word—usually slight hesitation—often repeated—inserted or omitted word—changed order—apparently shifting attack to try and get thought"; "appearance—studies word-length, general shape, some one striking clue"; "mechanical analysis." The number of methods used was next compared with the achievement of the pupils in both oral and silent reading. The results showed clearly that the pupils who made use of all four methods were superior on the average, in both types of reading; the average achievement of those using three, two, and one method was correspondingly less.

Value of Phonetics

The specific values and limitations of phonetics as an aid in learning to read were studied by Garrison and Heard (560). The pupils included in the experiment began school in September 1927 and continued through the first, second, and third grades until May 1930. The children were divided into two groups—the phonetic group, receiving training in phonetics during the first two years; and the non-phonetic group, receiving no such training. Both bright and dull children were included in each group. There is some question concerning the adequacy of the control of all the factors involved. Detailed studies of the achievement of pupils in reading and spelling were made at the end of each year; the amount of loss during summer vacations was also determined. The data collected led to the following conclusion: "Training in phonetics makes children more independent in the pronunciation of words"; "children with no phonetic training make smoother and better oral readers in the lower grades"; "bright children profit more than dull children from the early introduction of phonetics"; "for all children, phonetic training seems to be more effective in the latter part of the primary grades"; "the phonetic group made more progress in spelling than the non-phonetic group"; "the first-grade children with no phonetic training seem to lose less during vacation than do children with such training." These findings suggest that there are many issues which must be considered in reaching final conclusions concerning the place and value of phonics in the primary grades.

Value of Activities and Integration in Promoting Growth in Reading

Several studies have been reported concerning the value of activity curriculums and integrated programs in promoting growth in reading.

J. M. Lee (580) reported the results of a first-grade reading survey in California which showed that the schools which reported "a great deal of activity" ranked definitely lower in silent reading achievement than those reporting "some, very little, or no activity work." In all probability many of the schools reporting a great deal of activity also provided systematic training in reading. It is unfortunate that more precise records of the amount of activity used in the different schools was not secured.

Hopkins (572) reported the progress of the pupils in grades two to eight inclusive in the Lincoln School of Teachers College, Columbia University, which follows an "activity curriculum" in which relatively less attention is given to formal instruction in reading than is provided in a subject curriculum. The results of the Stanford Achievements Tests showed that the pupils make achievement scores comparable to those of like "age, grade, and intelligence in the general school population." Unfortunately, these tests do not measure progress in all phases of reading. Furthermore, no report was made concerning the number of problem cases which develop or the amount of individual help which is provided.

Meriam (590) reported the progress in reading of Mexican children who attend a school which follows an "activity curriculum." The objectives of the school are not achievement in the three R's, but rather play for wholesome fun; "stories for a higher type of leisure," and "hand-work that is useful and ornamental." Definite effort is made to stimulate interest in attaining these objectives. Provision is made for much silent reading by each pupil. There is oral reading in groups, but never to the teacher merely to show how well they can read. Books are read at home, not as assigned work, but by choice to enjoy the story. Measurements of achievement in reading in the first four grades showed more than the normal amount of progress. It is obvious that the reading program followed involves many distinct phases, including some systematic training, and that the study was too loosely controlled to justify final conclusions.

Crawford and L. Gray (550) measured the progress in reading between September 11 and January 29 during which a fifth-grade English class devoted itself to "a puppet show activity." The progress as measured by the Stanford Reading Test was somewhat greater in both reading vocabulary and comprehension than is normally attained. Howell, Dunn, and Stoker (574) reported the progress in reading of pupils in grades three to six inclusive of a school in which an "integrated program" is followed. The results showed "satisfactory results in fundamental skills." Unfortunately, no statement was made concerning the extent to which systematic training in specific phases of reading was provided.

Individual and Group Differences

It is often assumed that if bright children are assigned to the same section or class, the result is a homogeneous group. Scheidemann and M. S. Smith (604), in a survey of an opportunity room for gifted children, found that they may be average or inferior in other traits. It follows that only one of many variables has been held constant when pupils are grouped on the basis of intelligence, and that teachers of reading must study the individual differences and need of bright as well as of slow children. In order to determine differences in the study habits of sixth-grade children, Mitzelfeld (592) organized a questionnaire under four different headings, namely "pronouncing unknown words," "finding the meaning of unknown words," "behavior in work-type reading," and "behavior in recreational-type reading." The pupils were classified into two groups: Group I, those who had reading difficulties; and Group II, those who did not. Significant differences among groups were noted in the replies: Group I showed a greater tendency than Group II to pay no attention to unknown words and to read right ahead, to pronounce words in a loud whisper, and to use the dictionary more frequently when they did try to determine the meaning of unknown words. Group II showed a greater tendency than Group I to guess at the pronunciation of words, to look for little words or parts of words in unknown words when trying to determine their pronunciation, to use the dictionary wisely in getting pronunciations, to determine meanings from the context, and to look up words only when they were key words.

A partial explanation for some of the individual differences reported is found in the fact that a given pupil differs from time to time in many essential traits and qualities. For example, Dewey (554) found, in a study of the consistency of pupil responses to a comprehension test, that bright pupils were not consistent more than two-thirds of the time and dull pupils not more than one-third of the time.

Classifying and Adapting Reading Instruction to Needs of Pupils

Several experimenters reported evidence of the value of classifying pupils and providing instruction in reading adapted to their needs. Clark (548) graded pupils primarily on the basis of chronological age, classifying them within each grade chiefly on the basis of reading ability. McElwee (585) formed homogeneous groups in grades 1A to 4B on the basis of intelligence scores, reading achievement scores, and teachers' estimates of their ability. Dvorak and English (557) studied the needs of fifty pupils in grades 3A to 6A inclusive who showed the greatest deviation from normal expectancy and adapted instruction to their needs. Horrall (573) compared the progress of selected and unselected groups at the fifth-and sixth-grade levels. H. A. Gray and Hollingworth (566) compared the achievement of gifted children enrolled and not enrolled in special opportunity classes. All of these studies supplied conclusive evidence of the value of adapting instruction to the needs of each group. Mere segregation, however, without adaptation of instruction, was shown to be ineffective. In the case of superior children, "the advantages to be hoped for from homogeneous grouping" are "not so much in expectation of greater achievement in the tool subjects (reading, arithmetic, spelling) as in an enrichment of scholastic experience with additional intellectual opportunities" (566:261). As is shown clearly by Dransfield (555), opportunities for enrichment can be increased by reducing the recitation time and providing "self-administering instruction units" which can be pursued independently under the guidance and direction of the teacher.

Relative Merits of Different Methods of Improving Silent-Reading Achievement

Limb and Parker (581) conducted an experiment in grades three to seven inclusive in Australia to determine the relative merits of regular class teaching of reading with and without the use of the Crabbs-McCall test lessons in reading. The results led to the conclusion: "It is possible, by practice for two or three half-hour periods weekly, to improve the efficiency of a primary school group in one specific type of comprehension; but there is little evidence that the amount of practice which can be given in three months is sufficient to result in permanent improvement" (581:48). In a comparative study of the merits of "workbook material" and "picture-dictionary material" at the first-grade level, Pierce and Quinn (600) found that there was very little, if any, difference in the gains made by the groups using the respective materials, as measured by the Pressey attainment scales for grades one and two. In tests of word recognition, however, "the picture-dictionary material is at least equal to, and possibly has a certain degree of superiority over, the workbook material" (600:603). The fact should be pointed out that the materials compared were designed for different purposes and that the progress achieved through their use is hardly comparable.

Two experiments have employed extensive library reading. Hilliard (569) compared extensive library reading with specific drill as a means of improving silent-reading achievement among fifth-grade pupils. The Sangren-Woody Silent Reading Tests were used in measuring progress. At the end of eight weeks, both the extensive library group and the specific drill group made larger average gains than did the control group which followed the usual reading procedure. An analysis of the scores made on the separate parts of the tests showed that "extensive library reading seems to produce larger gains in such abilities as rate, total meaning, and following directions; while the specific drill method secured greater growth in knowledge, fact material, central thought, and organization" (569:11). Glover (564) compared the progress of fifth-grade pupils as a result of "systematic skillful instruction" in reading and of extensive library reading. The results, as measured by the Sangren-Woody Silent Reading Tests showed that the latter method was more effective than the former in the case of both bright and slow pupils. Unfortunately, the gains on the different parts of the test were not reported as in the case of Hilliard's study.

The foregoing studies justify the conclusion that various types of training, including wide independent reading, have specific value in improving reading achievement. It remains to determine the conditions under which each type can be used most effectively.

Methods of Improving Reading Achievement in the Content Fields

W. S. Monroe and Engelhart (594) summarized the results of various studies relating to the need for and methods of teaching the reading of arithmetical subjectmatter. They concluded that pupils should receive appropriate training, but that further research is necessary to determine the nature of instruction that is most effective. In a subsequent study (595), the value of systematic training in reading verbal problems was studied in the case of fifth-grade pupils. Unfortunately, the conditions under which the experiment was conducted were not sufficiently controlled to justify final conclusions.

Value of Practice Exercises of the Work Type

Closely associated with studies of methods of improving reading achievement in the content fields are those which aim to determine the value of exercises in reading of the "study" or "work type." Jacobs and Liveright (575) gave specific training to fourth- and fifth-grade pupils to improve ability to find answers to questions, to follow directions, to discover the central thought, to decide upon the total meaning, to organize thought in various forms, and to increase rate of reading. Sibley (606) diagnosed the needs of third-grade pupils with respect to each of the phases of reading listed above and provided special training adapted to the needs of the pupils. The results of both studies showed "the undoubted value of definite attention to the teaching of study-type reading" (575:459). Gatto (563) reached similar conclusions in a study among fifth- and sixth-grade pupils to improve vocabulary, the selection of central thoughts, the location of information, outlining, original questions, recall, following directions, reproducing, answering, problem-solving, interpreting of tables, summarizing, etc. The gains were greater in the sixth-grade sections, suggesting that a certain degree of maturity may be essential for maximum gains, or that materials and methods were better adjusted to the abilities and needs of pupils in the higher grade.

The Direct versus the Incidental Method of Increasing Meaning Vocabulary in History

The problem of increasing the meaning vocabulary in the content fields is a very challenging one. In order to determine the relative merits of direct and incidental methods, E. Holmes (571) conducted a series of experiments with fourth-grade history classes. The results showed the superiority of the direct method in increasing vocabulary, in improving both oral and silent-reading achievement, in promoting fluency in oral discussion, and in sustaining the child's interest in a topic.

Growth in Meaning Vocabulary in Mathematics

Pressey and Moore (601) gave vocabulary tests, covering 106 technical words in arithmetic, 49 in algebra, and 88 in geometry, to determine growth in meaning vocabulary in these fields from the third grade through high school. The results showed that certain terms, such as "minus," are learned early and remembered. Other terms, like "altitude," are learned slowly but steadily. One of the striking facts emphasized by the test papers was the inadequate mastery of the fundamental vocabulary of the field by many pupils.

Relation between Rate and Comprehension

Tinker (613) summarized studies of the relation between rate and comprehension, pointing out the fact that at least three different technics have been employed by investigators. In the first, rate is compared with ability to recall what is read; in the second, rate and comprehension scores have been obtained on different materials; in the third, rate and comprehension have been measured on identical materials. The correlations derived have been consistently high in the latter case. Tinker maintained that the third method is the only valid one to use. Data secured on this basis justify the conclusion that "there is a close relationship between speed and comprehension in reading." The fact should be pointed out that the term "comprehension" is used somewhat loosely in this study. The results may differ for completeness of comprehension and for depth or level of comprehension.

Factors Involved in the Appreciation of Literature

Mrs. Smith (607) prepared a list of sixty-eight factors regarded by experts in the field as involved in learning the arts. Questionnaires were distributed to teachers of English and reading in twenty higher institutions during a summer session with the request that the items be listed in the order of importance in developing appreciations. Returns were received from twelve institutions. There was general agreement that the following factors ranked high in importance: "comprehension of meaning"; "ability to correlate the thought of the selection with the learner's past experiences and to recognize the familiar"; "learner's imagery—power or ability to get word pictures, including the ability to recall, invent, and review past experiences"; "students' attitude, whether favorable and receptive including feeling of at-homeness and self-identification"; "adaptation of material to the learner—ease, sureness, confidence, and facility in reading"; "appeal to the interest of the learner so the selection will attract his attention and arouse him to action"; "character of the initial presentation"; "practice in reading good literature." This list is very illuminating and suggestive. There is a danger, however, that some of the terms used may not be uniformly interpreted. Furthermore, experimental studies of the factors named are essential before the validity of the ranks assigned to them can be fully accepted.

Relationship between Intelligence, Reading Ability, and Other Factors

The relationship between social, economic, and personal characteristics, especially intelligence and reading achievement, has challenged wide interest. Ladd (577) gave group tests of "silent reading, intelligence, socio-economic status, play interests, personality, and school attitudes" to 315 pupils in grades 3B to 5A inclusive in three schools of New York City. No marked relationships were found between reading achievement and socio-economic status of the home, play interests, or general personality adjustment. The correlation between reading age as determined by three tests and the Haggerty Intelligence Examination Delta 2, was .71, and between reading age and the Pintner Non-Language Mental Test was .24. The use of reading in the Haggerty Test doubtless contributed to the higher correlation. Evidence in support of this assumption was presented by Durrell (556) who found that intelligence scores varied with the leading achievement of children, by Lowry (584) who studied the gains made on intelligence tests after reading achievement had been increased, and most clearly of all by D. M. Lee (578).

In an elaborate study of reading in grades four, five, and six, D. M. Lee (578) gave a battery of intelligence and achievement tests and studied the relationships of the scores. She found that "the correlations between reading scores and mental age are appreciably higher (about .30) for the sixth than the fourth grade. . . . The correlations between reading scores and I.Q.'s show no consistent trend through the grades." By an ingenious statistical device she eliminated the influence of intelligence from achievement in school subjects and reading. The resulting data showed a high correlation between achievement in reading and the other subjects. "The correlations between reading scores and achievement scores are highest for the fourth grade (about .79), but higher for the sixth than for the fifth." She found, furthermore, that reading ability of less than a grade score of 4.3 was detrimental to the progress in school subjects of all pupils regardless of I.Q. in grades four and above. She concluded therefore that "it is most important for each fourth-grade pupil to acquire an ability to read general material at least equivalent to the beginning fourth-grade norm" (578:60).

Stevens (609) correlated the scores of several hundred pupils in grades three to seven inclusive on tests of "general reading ability, arithmetical reading ability, 'intelligence,' arithmetic problem solving ability, and ability in the fundamental operations of arithmetic," and found that tests of problem reading correlate higher with tests of problem solving than do tests of general reading or of fundamental operations. The investigator pointed out the need of further studies of relationship in this field.

Causes of Serious Deficiencies in Reading

The literature relating to unusually deficient readers has increased rapidly during recent years, as shown by a summary prepared by Tinker (612) of 180 studies of "diagnostic and remedial reading." The chief causes of reading deficiencies which were reported are low mental ability, congenital word blindness, heredity, conditions related to cerebral balance, faulty basic habits, abnormal emotional-reaction tendencies, and deficiencies in visual, auditory, or kinesthetic perceptions and memories.

As a result of an elaborate study including 415 children, M. Monroe (593) classified the causative factors in reading disabilities under seven general headings: visual, auditory, motor, conceptual, methodological, environmental, and emotional. Under visual aspects of reading were "lack of clear-cut retinal images, due to defects in the refractive mechanism of the eye" and lack of precision in discrimination of "complex visual patterns" and of the "spatial orientation of patterns." Under auditory aspects of reading were "lack of auditory acuity due to partial deafness" and lack of precision in the discrimination of speech sounds and of the temporal sequence of sounds. Under motor aspects of reading were "lack of precision in the motor control of the eyes," of speech, and in "directional motor responses." Under conceptual aspects of reading were "lack of vocabulary" and "lack of facility in the organization of language." Various specific causes were listed under methodological, environmental, and emotional aspects.

Parker and Waterbury (598) reported the following "major causes of, and factors in increasing reading disability" as identified through observation and special study under school conditions: lack of kindergarten training; ill-advised placing of pupils in grade 1B to begin formal reading; pressure exerted by teacher to complete a given number of lessons; reliance on the volunteer response method of conducting drill, tendency to "belittle the learning power of pupils"; neglect of pupils pending clinical examination; failure to discover severe cases of reading disability; and failure to bring cases of marked disability to the principal's attention. Undoubtedly, these and other practices contribute to slow progress in learning to read.

Various investigators have been interested of late "in the relations of lateral dominance of the hands, eyes, and ears, and visual acuity and eye-muscle imbalance to difficulties in reading." For example, in an extended study of lateral dominance and visual fusion, Selzer (605) found a definite correlation between muscular imbalance and mirror reading, as well as the type of difficulty characterized by reversals, omitting letters, and substituting letters. His studies led him to the extreme conclusion that muscle imbalance and alternating vision account for most, if not all, of the reading disabilities not accounted for by general mental disability. He described and made use of a technic for detecting muscle imbalance and showed that the reading defects resulting from it can be corrected through the use of prisms in lenses.

Within the last few years, the theory of the relationship between dominance and reading disability has gained wide recognition. However, increasing skepticism has been expressed during the last three years concerning its validity. For example, Crider (551) pointed out the need for more experimental evidence relating to the issue. Gates and Bennett (561), after an extended study of reversal cases, advocated the "acquired habit" theory rather than the "brain organization" theory in explaining the relation of handedness and eyedness to reversals. Dearborn (553) preferred to explain reading disability in terms of the direct influence of left-eyedness and of mixed and of crossed conditions upon the process of learning rather than in terms of cerebral localization as proposed by Orton.

The practical difficulties caused by reversals in reading have led to much study of their causes. The various studies of reversals by Gates and Bennett (561), Phillips (599), Dearborn (553), Woody and Phillips (619), and others do not provide conclusive evidence of an invariable relation between handedness or eyedness and reversals. These findings give support to the view of Gates and Bennett and of Dearborn which were reported in the preceding paragraph.

One or more specific causes of reading disability have been emphasized by different investigators who have reported studies during the last three years. For example, Hegge, Sears, and Kirk (568) discussed a number of cases of reading difficulty due, in part, at least, to mental retardation or deficiency. Richards (602) explained the deficiency of one case in terms of deficient visual imagery. Eames (558) found that in the case of poor readers the eyes are more exorphic at the reading distance than is normally true, and that hypermetropia is also more common. Anderson and Kelley (538) found that boys are more frequently poor readers than girls and that speech defects are more common among poor readers than others. Birdsall (541) reported that retarded and superior readers differed "in methods of attacking unknown words," "in methods of reading," and "in imagery and association." Further studies are necessary to determine the extent to which such factors are definitely causal.

Remedial Procedures in Reading

An unusually large number of studies dealing with remedial procedures have been reported. Unfortunately, many of them are so technical in character that they are of value chiefly to the clinical psychologist. The major findings, however, have significant implications relative to classroom practice.

The most elaborate discussion of remedial procedures published during the last three years was prepared by M. Monroe (593) as a result of diagnostic and remedial studies involving 415 children. The methods recommended relate to the following difficulties: faulty vowels and consonants, reversals, addition of sounds, omission of sounds, substitution of words, repetition of words, and addition of words. Because of their detailed character, it was impossible to summarize them here.

In a summary of the remedial treatment reported in previous studies, Tinker (612) called attention to several specialized technics used in severe cases of reading disability: the old-fashioned *a-b-c* method, including the spelling of words, recommended years ago by Hinshelwood; phonetic spelling by Schmitt; the kinesthetic method of training non-readers, recommended by Fernald and Keller; and a modification of the kinesthetic method by Gates in which print rather than script characters are used in writing and in which greater emphasis is placed on similarities and differences in words. Tinker pointed out that experimental evidence was lacking to indicate which of these methods was the best. In some cases, they were organized to serve distinctly different cases.

The studies relating to reversals suggest a variety of methods for preventive and remedial purposes. Teegarden (610) suggested that right habits are initiated in the kindergarten, as children give close attention to form, position, and sequence in various activities, including the manipulation of materials, make discrimination of size, form and color, see similarities and differences, and form judgments. Gates and Bennett (561) emphasized the importance of the "explanation and demonstration of correct eye-direction of attack," the use of a primer dictionary, the "introduction of study of word characteristics," in certain cases, the use of the finger as a guide, the use of other motor aids, such as those recommended by Keller and Monroe, and the vocalization of the word elements as they are seen.

In dealing with special disability cases, characterized by muscular imbalance, suspenopsia, and alternating vision, as well as reversals, Selzer (605) found that special lenses with prisms were very helpful. In cases similar in many respects to those of Selzer's, Dearborn (553) recommended the tracing method as the words are pronounced, "thus synchronizing the movements of the hand and eye with the sounds of the words." In the case of the older children the use of the typewriter in learning to read may prove very valuable. Of even greater importance, according to Dearborn, is the individualization of instruction and sympathetic guidance.

Hegge, Sears, and Kirk (568) in a study of mentally retarded pupils presented arguments and evidence in support of the contention that nonreaders and poor readers may be "true reading cases" as judged by three factors: the existence of a specific retardation in reading as compared to mental age and arithmetical computation ability; the prevalence of anomalies of reading and other anomalies which in reading cases of normal intelligence may be taken to explain the retardation in reading; and trainability, the tendency of reading anomalies to disappear and reading grade to go up. In harmony with this theory, the methods employed in their study were adapted to special needs as revealed through diagnosis. Kirk (576) applied the tracing method to a group of subnormal children and found it more effective than the use of a conventional sight method. He pointed out, however, that further research is necessary to determine if this conclusion "is applicable to all subnormal children, to normal children, or whether the subnormal and the normal differ in these respects." The need for further discriminating studies in this connection is emphasized by the wide use of the tracing method reported by Woods (618) and others among non-readers who are seriously deficient in reading.

In dealing with "a case of reading disability due to deficient visual imagery," Richards (602) reported the use of the following methods: learning the alphabet, establishing sound association with letters and words, using writing to promote "kinesthetic-visual-auditory" associations, and repeating constantly. In summarizing the study, Richards maintained that a few hours of special attention to insure a phonic basis would have prevented reading disability in this case. Such a conclusion is interesting but lacks scientific evidence as far as the data presented are concerned.

Reading Interests

Three summaries of children's reading interests and preferences have been published during the last three years. One was published by the National Education Association (597) to determine answers to such questions as: What do children read? What factors influence their choices of magazines and books? The studies reviewed are reported separately. A second was prepared by the Sub-Committee on Reading of the Section on Education and Training of the White House Conference on Child Health and Protection (591). It emphasized the significance and present status of children's interests in reading and the need for more adequate reading materials and library facilities. The third was prepared by Coxe (549) and was concerned particularly with the amount of independent reading which children may be expected to do, the kinds of books and magazines which children read, the qualities which make books readable for children, and the methods which may be employed in arousing interest in good reading.

Abbott and Williams (537) made a questionnaire study of the magazine reading interests of 500 pupils in grades four to seven inclusive. The magazine which outclassed all others was *Child Life*. Other popular magazines were *Boys' Life*, *Playmate*, *American Boy*, *Open Road for Boys*, and the *National Geographic Magazine*. Many adult magazines were also reported frequently.

In a study of the reading interests of gifted children, Witty and Lehman (617) secured data concerning the same group in 1924 and again in 1929. The findings showed that "the amount of time devoted to reading increased with advance in chronological age," that there had been distinct changes in the kinds of reading enjoyed most, that the magazines read in 1929 differed widely in quality, and that the large amount of fiction read was undoubtedly the result of "special impetus and motivation provided by the home and the school."

The voluntary reading of unselected groups of children has been discussed in three extensive studies. A. Holmes (570) reported the quantity and quality of the books read voluntarily by pupils in grades four to eight inclusive in four public schools of Toronto, Canada. The average number of books read per month was about two. The range for the year was from 0 to 108. The average number read during the year by girls was 18.3 and by boys 15.3. The proximity of public libraries had a decided effect on the amount read. The percent of desirable books read varied from 29.8 in one school to 59.9 in another. The voluntary reading of boys and girls averaging eleven years of age who attend a given library in England was reported in terms of the books enjoyed most and the stories liked best (547). The younger girls enjoyed fairy stories most and the remainder "school stories." The boy was found to be "the much more interested and interesting reader. His interests are much more varied, and he generally knows when he comes to the library what he wants." Bell (539) reported the results of a study of the reading of fifth-grade children, white and colored, in Louisville, Kentucky, which indicated "similarity in reading interests of the two groups in spite of unequal reading ability." It was impossible to determine from the data presented whether the similarity was due to common interests or availability of the same kinds of books.

Boney (543) studied various phases of library reading in the primary grades, as reported in courses of study and professional publications. Nineteen suggestions for arousing the interests of children in reading were reported, such as making trips to the library; giving special programs, dramatization, pageants; using posters advertising books; providing an abundance of interesting reading material; encouraging pupils to help select books for the reading table. Gould (565) concluded a study of the classroom library by pointing out the following ways in which strong motives for and permanent interests in reading may be stimulated: through a knowledge of and interest in good books on the part of principals and teachers; by making books available to pupils; by the use of "good motivation on the part of teachers"; by reducing book reports to a minimum; and by a wise selection of simple, interesting books.

Children's Preferences for Pictures and Picture Books

Brief reference is made here to four studies which are concerned with children's preferences for pictures and picture books (559, 587, 588, 589). Although these studies are not concerned with reading in the limited sense of the word, the results have a direct bearing upon children's preferences for illustrated books.

Methods Used in Campaigns To Improve Reading Instruction

The value of carefully planned campaigns to improve reading instruction has been demonstrated repeatedly. The methods employed vary with the purpose of the experimenter and with the types of improvment desired. Lowry (583) tested the achievement of pupils in grades four to eight inclusive, provided time-pressure drills on easy narrative material, and organized drill exercises from history textbooks. Camp (546) diagnosed the needs of pupils in grades four to seven inclusive, provided specific training in accuracy of recognition and pronunciation, practice in oral reading, and specific standards relating to the form and quality of oral interpretation. Manwiller (586) made a survey of the reading achievement of pupils in Pittsburgh in grades four to eight inclusive and organized specific remedial programs based on the deficiencies and needs discovered. Appraisals were made of the value of specific methods of improving vocabulary, rate, fact material, total meaning, central thought and organization. Browning, Howard, and Moderow (544) gave tests to the 2A and 3A pupils of Louisville, reclassified them in the light of the test results, made individual diagnoses wherever necessary, advised the wider use of work-type material, provided special coach teachers in some schools, organized committees to study the specific practices needed by every teacher, and prepared bulletins of suggestions for teachers. Two distinct features of each of the campaigns described are the initial study of the achievement and needs of pupils, as advised by Sangren (603), and the adaptation of instruction to provide needed help and guidance.

In an elaborate study extending over a period of years, W. S. Gray and Whipple (567) made a careful survey of the achievement and needs of pupils and of the content and methods used; studied the findings with the teachers and school officers; advised needed changes in methods, equipment, and teaching materials; conducted teachers meetings at which methods of improving reading instruction were discussed; directed committees in the study of special problems; and supervised classroom teaching more or less intensively. Objective studies of the progress made by the pupils supplied clear evidence of the value of campaigns to improve teaching through the application of the results of scientific studies of reading. That the improvement was permanent was shown by the results of tests given one, two, and three years after the training period terminated. The study showed also the need for and value of adequate supervision.

Concluding Statement

A critical study of the investigations which have been reported suggest numerous questions of which two will be mentioned here. First, what reason is there to believe that the relatively rapid improvement secured in some of the special training experiments will be permanent? It is apparent that many studies relating to school subjects should be continued longer or checked at subsequent periods in order to reach final conclusions. Second, how much dependence can be placed upon the types of tests which are used today in measuring achievement or progress in reading? An increasing number of criticisms have been made during recent years concerning the validity of current tests of comprehension. If the basic instruments of investigation are open to question, it follows that the results of studies which involve their use may be challenged. The foregoing questions and comments suggest the need of more rigorous scrutiny on the part of investigators of the methods employed in conducting scientific studies.

CHAPTER VIII

Science

THERE have been striking changes during the past few years in the point of view that is guiding practices in science teaching in the elementary school. The Committee on Science Teaching of the National Society for the Study of Education (629) pointed to the discrepancies existing between practices in teaching nature study and practices in planning the program of elementary education. The committee also offered recommendations designed to correct, in some measure, these discrepancies. A unique feature in the report of this committee is the emphasis on thinking, problem solving, generalizing, and influences of learning on behavior. The wide acceptance of these recommendations accompanied by the rapid development of new curriculum material sets the stage for productive research. Acceptable studies already support the conclusion that children can and do think, solve problems, and generalize on the basis of experiences with science material. But the conditions favorable to such mental activities and the extent to which they are possible and practicable have not yet been carefully studied. No one questions the effects of learning on behavior, but there are very great questions concerning the nature of these effects and the conditions under which they occur. This new development in science for the elementary schools seems to place greater emphasis on intellectual processes than is common in the divisions of instruction in this school unit.

The work in this field during the interval covered by this report has been developmental and relatively few carefully controlled researches have been reported. Reviews of studies of science teaching in foreign countries are included for their contribution to understanding of special methods and psychology of instruction as interpreted by educators of other countries. The studies reviewed are arranged under the following categories: (a) American trends; (b) trends in other countries; (c) curriculum; (d) the learning process; and (e) effects of learning on behavior.

American Trends

The Thirty-First Yearbook, Part I, of the National Society for the Study of Education (629) presented "a general plan for an integrated program of science teaching; an adaptation of this general plan to the successive grades of each of the administrative divisions of the public school; and a suggested program for the education of teachers." Meier (627) showed that the recommendations of this yearbook have influenced practices in many school systems. Trends which he noted after an examination of courses of study of recent issue show a tendency toward a well-balanced program of work beginning in the first grade and extending as a continuous, integrated program of study through the secondary school. Clearly defined objectives are apparent and these function in the selection of materials included in the course of study.

In a historical study, Weller and Caldwell (634) outlined the major trends in instruction in nature study and in elementary science, particularly in the interval of 1870 to date. The contributions of content and method and the psychological background out of which these developments have come are briefly reviewed.

A committee headed by Weller (635) reported a survey of current practices. The report is based upon questionnaire returns from 172 schools distributed through 8 states. The average time allotment for science in these elementary schools was 72 minutes each week. Special science classrooms were in use in 20.4 percent of the schools. There were science museums in 22.1 percent of the schools. Methods and devices used in teaching in upwards of half of the schools included reading and discussion, experiments, projects, and field trips. According to this report some 56 percent of the schools used the unit plan.

A report by Hultz (624) is based upon an analysis of units of instruction submitted by the teachers of New York State to the state department of education. This analysis of general units gives an indication of the extent to which unspecialized teachers recognize science experiences in teaching.

Trends in Other Countries

Foreign trends show great variations, for the points of view guiding practices in foreign countries are by no means the same. Miller's report (628) of science teaching in France showed that the work is centered around objects particularly in the lower grades. For example, in the first two grades children are taught fruits and a few trees. In upper grades, this information is utilized in the study of orchard fruits and cereals. The program is outlined lesson by lesson.

Jones (625) reported observations of teaching science and nature study in the elementary schools of the Orient. He found effective work in progress in Japanese schools. Biological nature study was most in evidence in work with the younger children with increased emphasis on generalization following the fourth year. Special rooms were sometimes provided and experiences with science material are accepted as an established part of the curriculum.

Kilander (626) reported a thoroughgoing study of practices in science teaching in Sweden. His report is based upon study and analysis of printed matter and upon extended visitation in the schools. Science is taught as environment study through the first three years of the elementary school. This is closely similar to *Heimatkunde* of the German elementary schools. This study was introduced in order to effect a concentration of the foundation training in geography, nature study, and history and through certain projects to give training in drawing and sloyd. The aims of this subject include that of giving the children a planned study in home and community environment. "It should develop ability to observe, widen their conceptions, give an opportunity for expression, and make them more familiar with their local environment." "Nature study" follows environment study and is continued through the last three years of the elementary school. This "aims to give instruction about nature with special emphasis on conditions of plant and animal life and the basis for human life and preservation of health."

Shoemaker (632) reported an equally thorough study of natural science education in German elementary schools. It is based upon extended observation in German elementary schools and upon analysis of printed matter used in these schools. "Natural science education in the German elementary schools begins in the *Grundschule* in the subjectmatter of *Heimatkunde*. It forms the basis for the educative values of the entire primary curriculum." Of the aims expressed in the courses of study of seven German states, the one with the highest frequency is, "Knowledge of appreciation of environment through actual observation of natural objects and phenomena." In Germany, as in Sweden, the organization of instructional materials is about centers of interest which are inclusive of the natural and social sciences. The study reports in detail the natural science content in the course of study in *Heimatkunde* for the *Grundschule* in Hanover.

These reports on work in foreign countries show wide diversities in practices in science teaching and in elementary education in general. No careful evaluation of outcomes from these methods has been made.

Curriculum Studies

Psychological considerations have determined, in large part, the character of curriculum studies. Robertson (631) has reviewed and evaluated the curriculum studies pertaining to elementary science. The contrast between recent and older studies shows clearly the influence of modern psychology on curriculum study. There is clearly a shift from curriculum material suggesting objects for study to material suggesting ideas, understandings, and effects on behavior.

Psychology of Instruction

Carefully controlled studies of procedures in learning are not numerous. The problem attacked by Haupt (623) is probably most significant for its potential influence on learning procedures. In their program for teaching science, the Committee on the Teaching of Science of the National Society for the Study of Education (629) urged that generalization should occupy a prominent place in the science work of elementary-school children. Freeman (622), among others, questioned this feature of the report, saying that to the young child, phenomena may be more nearly just phenomena-happenings. In an experiment carried through the first six grades in an elementary school, Haupt (623) studied the ability of children to generalize with the range of phenomena suggested by the statement, "The sun is the chief source of energy for the earth." In this preliminary report of his more extensive study, he dealt only with the phenomenon of a green plant turning toward the light. From his results (briefly summarized in this article) he concluded: "The difference between the mental operations of the children of the first and sixth grades was not one of ability to generalize. The difference was one of complexity of the generalizations which were made." We must await his full report to learn whether or not there is adequate basis for this conclusion.

Robertson (630) investigated the relative effectiveness of a "study guide" and "developmental discussion" method of teaching elementary science in a fifth grade with respect to both immediate and delayed recall. Units as written by Craig (621) were considered suitable for the developmental discussion method. The same units were adopted by the experimenter (method not reported) for use with a study guide. Objective tests were used to measure the results. He reported the material selected appropriate for use by either method, but found no significant differences between the results obtained from the different experimental methods. The author stated (without citing evidence) that both methods give valuable training which informational tests cannot measure.

Arnspiger (620) reported a measurement of the effectiveness of sound pictures as teaching aids in elementary science. He used 950 fifth-grade children from 32 different classes in five different cities. The experiment utilized the "equated teacher" method. Pupils in the control groups were taught without the aid of educational talking pictures and pupils in the experimental groups were presented with three showings of a picture dealing with the topic undertaken during the regular class period. The showings were followed by discussions. The mean gain, as revealed by the testing was greater for the experimental group with every unit except one. Furthermore, the gains were statistically significant.

Effects of Learning on Behavior

Weller (633) studied the effects of instruction in elementary science on the attitudes of the children. In this case, the effects on attitudes were measured by study of the children's responses to test items including superstitions and popular misconceptions. Two units were selected and taught so that the attention of children and teachers was directed toward both attitudes and factual knowledge. Results from testing showed that equal gains were made in attitude and knowledge items. In a second part of the experiment three sets of tests were used: (a) a true-false test on attitudes, superstitions, and misconceptions; (b) a multiple choice test with items grouped in the order to measure observations, conclusions, and ability to verify conclusions; and (c) a test of factual knowledge. Three equated pairs of classes were used. In three of the classes attitudes and technics were stressed, while in the other three, only factual items were discussed. Results showed that attitudes and skills may be more definitely developed when they are consciously kept before the pupils. The weaknesses in this study are evidences of the difficulties attendant upon research of this character. The reader will certainly question the adequacy of the investigator's definition of attitudes and the validity of the tests.

The development of science materials for use in elementary schools brings to the center of attention questions of mental growth. This has unique features, for emphasis in educational studies in the elementary school has been upon learning the tool subjects. This new development promises to add to the experiences of young children a large measure of enrichment.

CHAPTER IX

Social Studies[1]

RESEARCH in the social studies at the elementary level is not extensive. The chaotic condition of the content and objectives, the exceeding difficulty of securing definitive results, and the concentration of investigators on the high-school level are some reasons for the paucity of results. While the following summary is in general restricted to the elementary level, some studies which are applicable at all grade levels are reported.

The problem of objectives will illustrate a typical difficulty in the social studies. Socially desirable conditions and ideals of economic justice appear to some as educational objectives. It would be rash indeed to say that the schools have nothing whatever to do toward achieving these ends, but the line of demarcation between goals attainable in or through the schools, and those which must involve all society is not easily discernible. Confronted with such a problem, it is small wonder that social studies teachers are bewildered and hesitant. Slowly, however, the research of patient teachers is producing some results. We are making some progress in the selection and grading of materials, and we are learning how to perform some small tasks with a great degree of skill.

The outward forms of a valid study in the field of the social studies are discernible. It is somewhat easy to select those studies which have the appearance of scientific exactness. In view, however, of the numerous and uncontrollable factors which operate in this field, it is exceedingly difficult to be sure that an apparently valid study or experiment is in reality valid. Conversely, it is dangerous to reject unceremoniously those studies which are lacking in some of the outward appurtenances. Consequently, the following summary tends toward inclusive mention to a greater degree than absolute scientific standards would allow. Even when this liberal procedure is followed many studies will fall outside the scope of this digest.

Three groups of studies are not included: (a) those which seem to apply primarily to the high-school level and which do not have obvious applications to the elementary school; (b) those which seem to have been carried on in such a way as to guarantee no assured conclusions; and (c) those which have not come to the attention of this reviewer. In view of the varied places of publication, the numerous repositories of theses, and the enormous number of so-called studies, the reviewer asks for the indulgent charity of the reader.

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[1] Acknowledgments for assistance in the preparation of these reviews are due Marian Compton and George Engberg, graduate students at the University of Minnesota.

grades; (c) that geography and history should be taught as separate subjects; and (d) that objectives should be realistically conceived and stated in terms of the actual outcomes. Pritzkau (679) found that junior high-school pupils are interested in materials dealing with adventure, war, travel, communication, life and customs, and mechanical improvements. Williams (700) found that we are quite unsuccessful in teaching biography. He asked 2,216 pupils in junior and senior high schools to name twenty-five leaders in human affairs with the reason for selecting each name. One thousand six hundred ninety-one different persons were mentioned as leaders. Many pupils could name fewer than ten leaders and a few could name more. Junior high-school pupils were more successful than those in senior high school. Many papers revealed a faulty sense of value, but there was marked ability to distinguish between real and imaginary characters. Political and military heroes and living persons were most frequently selected. Bible characters, classical names, and movie actors appeared infrequently on the lists. Deeds rather than qualities marked the reasons for selection. This study has significance for the curriculum maker and the textbook writer. Gunderson (654) found little duplication in 40 primary readers and almost no geographic material in them. Roach (681) examined 7 junior high-school texts in American history and computed the percent drawn from the other fields: economics, 18 percent; government, 15 percent; geography, 12.6 percent. This study seems to indicate that one of the objectives of the fusionists is being achieved through subjects. Rosenbloum (682) examined 5 junior high-school texts in American history and found a total of 857 different persons mentioned. Only 136 of these names appeared in all five of the texts. Statesmen, artists and musicians, military men, colonizers, scientists and inventors, explorers, educators, and religious leaders appeared in the order of frequency in which they are here mentioned. Reed and Wright (680) listed the interests of the children of the primary grades—communication, transportation, industries, the community, and people of other lands. Sisson (686) and Phinney (674, 675) attacked the statistical procedure in the selection of curriculum material and cited instances of its inadequacy.

Problems in Learning

Hart (656) collected and classified errors in geography. Many errors reported arose from inadequate vocabularies. Words such as "mouth" and "source" are frequently confused, and abstract terms like "climate" and "longitude" cause difficulties. Other errors arose from lack of skills and abilities, from misconceptions, and from confused associations. Teachers are guilty of all the errors reported and are probably the source of many of them. Howe (660) examined 1,300 children in grades three to six to ascertain their sense of direction. He found (a) that children do not acquire a knowledge of directions until they study geography; (b) that more than half of the pupils from grades three to six knew the directions, but that many errors were made; (c) that children are likely to associate directions with some local object rather than with natural phenomena; and (d) that boys appear to know directions better than girls. He suggested more drill in the teaching of directions. Aitchison (636) studied the numerous misconceptions concerning the use of the word "zone." He recommended the elimination of all mention of zones from fourth- and fifth-grade geography and the substitution of such terms as "low, middle, and high latitudes." Hoppes (659) found that pupils of the fourth, fifth, and sixth grades have very poor abilities in reading pictures for geographic purposes. Thorp (692) studied the ability of pupils in grades four to seven to read globes and maps, to use indexes and appendixes, and to construct and understand graphs. He concluded that incidental teaching of the use of geographic tools is a failure. He urged a more systematic grading of such skills and gave a suggested scheme. He stated that the circle graph is a junior high-school problem and that the bar graph is more difficult than the line graph. Thomas (691), after studying the performance of 355 pupils in grades four to seven, concluded (a) that the line graph is the most difficult; (b) that picture graphs, two-dimension diagram graphs, and circle graphs are the easiest for pupils of all grades; (c) that superior fourth-grade pupils can understand simple graphs; and (d) that seventh-grade pupils, with proper instruction and explanation, can interpret all simple graphs. Shaffer (683) studied the ability of pupils from the fourth to the twelfth grades to interpret cartoons. He concluded (a) that such interpretation improves markedly between ages twelve and fifteen; (b) that the process of reasoning and the types of errors are similar to those involved in reading; and (c) that junior high-school pupils can make abstract interpretations of cartoons.

Study Methods

Barton (641) undertook to ascertain the value of outlining in the study of ancient history, geography, and American history. Matched groups in three types of school were employed. The variable factor consisted of direct and regular instruction in outlining. On the basis of subjectmatter tests the experimental groups made greater gains than the control groups. The differences were, with the exception of one unit, statistically significant. Fowlkes (652) has probably thrown some light upon the question of whether the study period should follow or precede the recitation. On the basis of a rather inconclusive experiment, he thought the study-recitation plan better than the reverse for the 7B class in American history. Newlun (671) studied the effect of teaching the art of summarizing. On the basis of experimenting in three schools for twelve weeks he concluded (a) that fifth-grade pupils can be taught to make creditable summaries; (b) that such training is probably more effective than conventional study methods; (c) that such training is unlikely to affect achievement in reading; and (d) that such training does not interfere with achievement in other directions. Simpson (685) undertook to determine the effect of specific training on ability to read historical materials. The scores from 606 pupils from the fifth, sixth, and seventh grades in and near Pittsburgh were utilized as the basis for conclusions. He found (a) that reading ability improved upon receiving training in answering questions, in evaluating, in outlining, and in summarizing; (b) that organizing of materials should precede attempts to answer questions; (c) that outlining was the most effective single method used; and (d) that specific training in answering questions, evaluating, outlining, and summarizing was more effective than the usual classroom procedure. Weaver (697), in two cautiously reported experiments, indicated that on the basis of test scores extensive reading is certainly as effective in American history as is intensive reading. He suggested that too much written work may be required in history. Winch (705) concluded that dates are easier to learn than centuries and that the teaching of specific dates results in a much greater aggregate of chronological knowledge. Wrinkle (709) taught a control group by assignment, study, and recitation and an experimental group by the same steps applied to the whole unit. He found that the latter method was superior in subjectmatter acquired, in increased interest in additional reading, in improved study habits, and in pupil preferences. He recommended a compromise between the short daily assignment and the long inclusive unit. Wright (708) concluded that motivation by means of pupil-prepared questions or by a teacher-prepared guide greatly increased the results of study in fourth-, fifth-, and sixth-grade history. He failed, however, to give a sample of the guide, to tell just where the experiment was conducted, the exact number of pupils, and how the materials differed in the various grades. Johnson (661), in a sadly misnamed volume, summarized some outstanding steps in the history of methods of teaching history. He contended that everything worthwhile in method has been known and utilized for many years. He is somewhat scornful of much of the work in education. Simpson (685) found that children in grades five, six, and seven of Allegheny County, Pennsylvania, schools were able to organize historical materials better if they first had training in answering questions, evaluating, outlining, and summarizing. Outlining appeared to be the most valuable operation and the one which should come first in the sequence.

Problems in Teaching

Van Bibber (693) discovered that almost every step in the teaching process was beset with difficulties. She recommended (a) few topics, (b) more careful grading, (c) elimination of some topics, and (d) more ample provision of materials. Wirth (706) described 71 difficulties which were reported by 1,417 teachers. Some of the difficulties pertain to pupils, some to materials, some to social situations, and some to shortcomings on the part of the teacher. Cox (648) compiled a great number of difficulties and classified them into 86 types. One of the interesting outcomes was the discovery of the inability of teachers to define their difficulties.

Baker (638) simplified the reading materials for 300 eighth-grade pupils in history. He found that simplification by synonyms was not effective, but that the substitution of equivalent but simpler phrases did effect an improvement in understanding. Weaver (696), after studying two control groups, each of twenty-one seventh-grade pupils, concluded that formal instruction is better than informal instruction for the elimination of errors in written work in history when used on groups of average or near-problem pupils; it also appears from this study that superior pupils progress equally well under either method of instruction.

Geedy (653) found that, in geography, slides before the lesson were more effective than graphs used to supplement the study period. Knowlton and Tilton (665) studied the effects of motion pictures upon a seventh-grade class in American history. They found that the pictures effected a gain in causal relationships and in knowledge of persons and places. The experimental group evidenced, however, a distinct loss in time relationships. In a later study they (664) found that motion pictures were more effective in the classroom than when shown in the auditorium. Meador (670) studied the effects of still films upon 420 geography pupils from grades four to seven. He concluded (a) that such pictures were a distinct asset in the study of foreign geography; (b) that instruction supplemented by visual impressions is more effective than instruction alone; and (c) that visual impressions contributing to and forming the basis of verbal instruction constitute the most effective way to teach geography. Terry (690) discovered that junior high-school pupils are more interested in the people featured on the screen than in any other type of material. Way (694) reported that 40 percent of the 44,186 motion pictures used in 517 schools were devoted to the social studies. Wolfe (707) concluded that superior children profit least from motion pictures.

Vocabulary Studies

Using eight senior high-school texts, Barr and Gifford (640) compiled a vocabulary of American history. Proper names, the first 3,000 words of Thorndike's list, and other groups were excluded. Seven thousand six hundred thirty-one different words occurred in the eight texts. The final list consists of the 1,900 most frequently used words. Hatch (657) discovered that 99 percent of his American history list of 1,082 words would probably cause difficulty. He concluded that the average text in American history for the senior high school is too difficult. Hathaway (658) concluded that history texts designed for the fourth grade contain too many difficult words. After equating two groups from the 4B grade, Kueneman (666) studied the relative difficulty of selections from the text and selections simplified by rewriting. He found that such simplification aided understanding to a rather slight extent. Parker (672) discovered that texts in modern European history possess a needlessly difficult vocabulary. L. C. Pressey (678) compiled a vocabulary of 228 words in elementary-school geography. Pressey and Pressey (677) compiled a vocabulary of 384 words in elementary American history. Stephenson and McGehee (687) found a list of 283 words which are common to both civics and American history. Kelty (663) compiled a word list of American history for the middle grades. The list consists of 711 words and terms, 83 percent of which appear in Thorndike's list. Each word is checked to indicate its appearance in various other lists. The compiler suggested specific exercises and drills to insure an understanding of the terms. Brown (645) examined 10 sixth-grade readers and histories for the difficulty of the diction. He found the histories more difficult than the readers—so much more difficult that he suggested the advisability of rewriting the former. Lacey (667) studied the social concepts of 450 children in the first three grades. The unique aspect of her technic was the use of tests based upon pictures. She proved that children of the first three grades have little conception of such abstract terms as "thrift," "patriotism," "industry," and "courtesy"; that differences within grades are more significant than between grades; that the curriculum has a direct bearing upon the understanding of the concepts; that concepts involving personal relations are more difficult than those involving objects; and that the many misconceptions revealed point to the necessity of more careful teaching. Harrison (655), by interviewing 160 children, studied the nature of fifty commonly used concepts of time and their development from the kindergarten through the third grade. She reported a gradual development from grade to grade. In fact, the correlation between the development of time concepts and grade advancement is .66. This, and several other studies, seem to indicate that our grade placement of materials is not the woeful failure which is so often depicted. The author showed, however, that the correlation between grasp of time concepts and mental age is .70. The author does not name any of the concepts studied. Two articles on the subject of vocabulary studies may prove useful to those who plan research in the field. Dale (649) gives some specific suggestions, and Wesley (698) raises some problems concerning the use of word lists.

Measurements

Weaver and Traxler (695) found that essay and objective tests are about equally valid when the essay test is scored as objectively as possible. Anderson and Lindquist (637) analyzed the meaning of the term "achievement tests" and gave suggestions for the construction of valid items. Peters and Altman (673) made a critical study of standardized tests in American history. They examined twenty-three tests which appeared between 1916 and 1929. They classified 67 percent of the items as political, 22 percent as social or economic, and 10 percent as military. Tests tend to pay scant attention to recent events. In general, they fail to show a very close agreement with scientifically ascertained standards in respect to proportion, dates, names, and areas explored.

CHAPTER X

Spelling

THIS summary of investigations in spelling covers the period from January 1, 1931 to June 30, 1934. It is confined to published studies and continues, in similar form, the summary that appeared in the *Review of Educational Research* for a like period three years ago. The content of the investigations, of which there are 67, will be discussed under the following major headings: (a) bibliographies; (b) selection and gradation of vocabulary; (c) methods of instruction; (d) measurement of achievement; and (e) deficiency and diagnosis. Inasmuch as a previous number in this cycle of the *Review of Educational Research* discussed curriculum problems in various subjects, including spelling, attention will here be given chiefly to spelling problems outside the field of the curriculum.

Bibliographies

During the period under consideration a number of helpful bibliographies have appeared. Foran and Sister Mary Carmela (731) prepared an annotated bibliography of 82 references to supplement the bibliography of Sisters Mary Irmina, Mary of the Visitation, and Mary Gabriel which appeared in 1928. Breed (714) summarized the results of 83 studies, covering the period 1928-30. Zyve (776) prepared a summary of 57 investigations, reports of which were published during the same three-year period. Gray (746) compiled an annotated bibliography of a selected list of 17 investigations, the results of which were published during the year 1931-32. A similar bibliography of 12 entries for the following year was contributed by Breed (713). Most recently of all, Horn (750) reviewed 44 studies that were published during the triennium ending November 1, 1933.

One of the undesirable features of this bibliographical work is the duplication of effort. Reviewers working presumably in different fields frequently use identical material in identical manner. Another is the frequent failure to report the result of an investigation.

Selection and Gradation of Vocabulary

The interest in children's out-of-school writing as a source of words for the spelling vocabulary, continues to grow. Driggs (726) made a study of word usage in 192 letters of pupils twelve to fifteen years of age. His results are quite similar to those previously reported for college freshmen and adults. Fitzgerald (727) found the frequency of use and of misspelling for 7,587 different words appearing in children's letters. He showed the disparity between the word usage of children and that of adults, and provided new data on the distinctive elements in the vocabulary of children. It is true, as Horn (750) pointed out, "that the overlap between the writing needs of children and adults is so large as to furnish, grade by grade, an abundance of words which pertain to the child's present needs and to his future needs as well." Nevertheless, Fitzgerald's data confirm previous conclusions to the effect that limiting the spelling vocabulary to this common element would exclude a considerable number of words that, as indicated by frequency of usage, are more important for the child than many otherwise included. It is the old question of permanent versus temporary values in curriculum making, the question as to whether the spelling vocabulary should be confined to material that directly meets the needs of maturity. The facts are clear; the principle is in dispute. Fitzgerald (728) also presented the 2,106 words of highest frequency in 3,184 personal letters written by children in the fourth, fifth, and sixth grades. On the basis of adult usage and the results of a survey of children's written English, Schonell (764) selected a list of 3,200 words for elementary schools in England.

As if further reminders were necessary, two articles suggest the lag between scientific knowledge and its social application. The first is an argument for simplified spelling, by the secretary of the Simplified Spelling Board (725). The economic waste due to our conventional spelling is estimated to exceed $1,000,000,000 a year. Experiments indicate, we are informed, that our present irrational spelling wastes at least a full school year in the life of every English speaking child. If reason could overcome the inertia of habit, if science could be substituted for the passionate worship of vestigial and irrational linguistic symbols, millions of elementary-school children might be freed from an enormous and an unnecessary burden. Croissant (723) discussed the difficulties encountered by the movement to establish simplified spelling. Coleman (718) undertook a critical analysis of methods of vocabulary determination and concluded that emphasis should be placed on the writing of both children and adults as source material. He rounded out his investigation with the selection of 3,017 words for use in the public schools.

In a series of articles that has recently eventuated in a book, Foran (730, 735) reviewed the important literature relating to the selection of the minimal word list in spelling, and, as regards method, reached essentially the same conclusion as Coleman. As to the size of the minimal list, he concluded that 3,800 is approximately the desirable number of words, this being the median number among 13 spellers in common usage. Foran (733) also examined the gradation problem, and concluded that the spelling vocabulary should be graded on the basis of "children's experiences with the meanings of words." Wise (774) also touched on gradation, reporting the results of a comparative study of 20 modern spelling texts. His results confirm those of other similar studies, in that great variability was found in the grade location of the same words in different texts.

Methods of Instruction

Basically, a method of instruction is a mode of directing learning activities. Instructional method should therefore rest on knowledge of the learning process. Hence, the persistent search for the fundamental factors in learning to spell.

Factors in learning—By analyzing 39 reports bearing on the topic, Williamson (772) derived the following as the factors which are important in learning to spell: (a) span of apprehension; (b) knowledge of meanings; (c) verbal intelligence; (d) perception of word form; (e) generalization of phonetic units; (f) rote memorizing; and (g) desire to spell. Williamson (773) also reported the results of an experiment from which he concluded that the conception of special disability in spelling should be discarded and that more attention should be given to skills of learning and general intelligence as important factors. Experimental data reported by Hartmann (748) seem to agree with the results of previous investigations that spelling ability is not a function of general visual perception, but depends upon immediate memory for meaningful visual stimuli. By Frandsen (737) it was shown that spelling efficiency has little or no relation ($r = .11 \pm .06$) to differences in the pleasant or unpleasant connotations of words.

Procedures and devices—Prehm (761) showed the improvement that ensued when pupils were properly motivated, grouped according to ability, given differentiated assignments, provided with individual instruction, and informed of progress. Zyve (775) in an extensive experiment made a number of comparisons of different methods of instruction and found most of the differences in results to be small. Four reports deal with aspects of the pretest method. Gates (741) found that the test-study method was inferior to the study-test in grades two and three. In an experiment conducted by Gates and Bennett (742) it was found that the test-study method operated more effectively in the primary grades with two tests per week than with three. After an experiment devoid of proper controls, Kirby (755) concluded that the test-study method is inferior to traditional methods. Springsteed (767) proposed a modified form of the pretest method. Miller, Courtis, and Watters (758) prepared a type of manual for persons interested in applying the project method to spelling, but reported no measurements of effectiveness. As an outgrowth of an eye-movement study, Gilbert (744) compared a flash-card method with a form of the pretest method. The most significant factor in the results seemed to be the limitation of time and its effect on application. As regards the flash-card, few would deny its efficacy as a device; few would claim its adequacy as a method. At the end of a three-year experiment, Garrison and Heard (739) found no significant difference in spelling ability between primary pupils trained in phonetics and those not so trained. Data on handwriting difficulty in spelling and on the relative difficulty of the various letters of the alphabet for primary pupils were provided by Hanson (747). Hughes (751) reported beneficial effects from differentiating both pupils and courses. Dean (724) outlined a plan of individual instruction to be used with any textbook, and Frostic (738) shed interesting light on methods employed in some of the earliest American spellers.

Generalization of ability—Caught in the web of our irrational spelling, we are still trying patiently to determine the extent to which formal rationalization is possible in instruction. Wheat (771) formulated four spelling rules of rather wide applicability. Their value in learning to spell should be determined by experiment. King (754) studied the results of applying seven carefully selected rules, then cautiously concluded "that all except two of the rules . . . were understood and applied by grade children with enough success to warrant further study." In a collection of more than 100 spelling rules, Sartorius (763) found fourteen that applied without exception to the spelling of 202 words in a minimal list of 4,065. Someone should now determine whether or not the 202 words can be mastered more economically with than without the use of rules. Carroll (716) showed quantitatively the greater tendency of bright pupils, as compared with dull, to generalize in spelling. As a result he (717) concluded that "likenesses between words in syllabic structure, in configuration, and in phonogrammatic units should be pointed out, and bright children will benefit." Garver (740), like Carroll, presented experimental evidence of the operation of generalization in spelling, and, in line with the results of previous experiments favoring the grouping of words according to identical elements, asserted that fairly constant irregularities and peculiarities, fairly uniform changes of primitives in making derivatives, and the like, demand special attention. In the light both of psychological principles and spelling research the recommendations of Carroll and Garver seem perfectly sound.

What above sixth grade?—For some time data on time allowance have indicated a decline of emphasis on spelling in the seventh and eighth grades. We seem to be tending toward a plan of completing the formal study of spelling in the sixth grade. However, many junior high schools that have discontinued the study have been haunted by the vexing problem of spelling deficiency. Recent investigations indicate a search for an economical method of meeting this situation. Forman (736) reported the results of the campaign method; Coverdale (721), those of the contest method. In the latter case, six high schools joined in a league of competition after adopting the same list of words. Even though these plans led to improvement in spelling, they do not seem to present the last word in the way of a solution. A plan seems to be demanded that rests on dependable incentives and gives greater assurance of uninterrupted success. A simple scheme that seems to be in considerable favor is illustrated by practice in the Theodore Roosevelt High School, New York (766). Eight spelling lists of 100 words each are submitted to pupils with suggestions designed to aid them in independent study. Urell (770) described a similar scheme adopted elsewhere. Anderson and Traxler (711) reported the results of an economical and effective plan of corrective group instruction for the removal of spelling deficiency among pupils in the seventh and eighth grades. Connelly (719) showed how the same kind of situation was met by the use of six minutes daily in English classes. There is obviously a need for a new type of course at this level, one sound in vocabulary, adequate and scientific in study guidance, workable on an individual basis, and markedly economical of the teacher's time. There is a gleam of consolation if not of hope in the results of an experiment by Gilbert (743), who called attention to the improvement in spelling ability from year to year in the high school regardless of the presence or absence of spelling instruction, and showed that this improvement is due, in part at least, to incidental learning in connection with reading.

General and comprehensive discussions—Several writers on spelling problems have presented overviews representing their reactions to a considerable body of the literature. Kyte (757) derived thirty-five principles for use in the teaching of spelling. Breed (712) endeavored in a short article to indicate the major trends in the field. Foran (732, 734) discussed the general type of instructional method to be employed and the major problems in the presentation of words. Almack and Staffelbach (710) reviewed the results of certain important investigations, the conclusions of numerous minor studies, and the opinions of textbook writers. Their discussion might have been improved by a more serious attempt to resolve contraditions at critical points and to show the trend indicated by the most reliable research.

Measurement of Achievement

Cook (720) conducted three experiments relating to technic in the measurement of spelling ability. The first dealt with the selection of test words, with special reference to difficulty and discriminative value; the second and third, to the evaluation of six self-administering test technics. The double-alternative spelling test was found by Phillips (760) to be low in validity ($r = .69$), much lower than the ordinary dictated-recall type. Kelley (752, 753) reported a study of five technics used in the measurement of knowledge of the meanings of words, including the familiar multiple-choice test, and concluded that, while all were high in reliability, none was high enough in validity for satisfactory individual measurement. Thurstone (768), in agreement with previous investigators, found that for greatest validity of measurement, other things equal, the mean per cent of correct spelling for the group measured should be about 50. Contrary to the common assumption, Capron (715) concluded that the order of arrangement of items in spelling tests has little effect on the scores of pupils in the upper elementary grades.

Deficiency and Diagnosis

In four instances studies of misspelled words were reported. Crawford and Garrison (722) showed the disagreement between a list of words misspelled by seventh- and eighth-grade pupils and other lists of most commonly misspelled words. They also showed the extent to which the words in their list were found among the later thousands or not at all in the Thorndike list. Hayes (749) published a small list of words misspelled by junior high-school girls in courses on clothing, and Kramer (756) the seventh instalment of a study of words misspelled by adults. Fitzgerald (729) made the most extensive study of misspelling during this period, reporting results based on 20,142 errors found in 460,906 running words of letters written by children in the fourth, fifth, and sixth grades. The remaining reports may be classed in the field of individual diagnosis. Muchow (759) determined the causes of spelling deficiency in two cases, one of difficulty in articulation, the other of difficulty in the perception of form. After investigating causes of weakness in spelling, Selzer (765) concluded that deficiency may be attributed in many cases to a disturbance of lateral dominance in the cerebrum. Ulrich (769) and Roback (762) did not fully agree on the causation of lapses. The former offered a Freudian explanation. The latter rejected the Freudian view of unconscious motive and concluded that "the principles of preservation and assimilation as explanatory of most of our lapses are . . . established beyond a doubt." Finally, Gilbert (745) reported the results of an investigation that has suggestive value for educational diagnosticians. The investigation showed the possibilities of the photographic method in the study of cases of spelling deficiency.

Reflecting on the data of objective studies, one can hardly avoid the conclusion that the objectives of spelling instruction are quite clearly determined. The words that should be taught are fairly accurately known. But the teaching of spelling still appears to be needlessly stiff and formal. If few new principles of instruction come to the surface in a summary for a triennium, the chief problem naturally becomes that of applying with increasing skill the principles already established. This, it seems to the writer, is the important task for the immediate future.

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REVIEW OF EDUCATIONAL RESEARCH

Official Publication of the American Educational Research Association, a department of the National Education Association.

The contents of the REVIEW are listed in the EDUCATION INDEX

Volume V **April, 1935** **Number 2**

FINANCE AND BUSINESS ADMINISTRATION

Prepared by the Committee on Finance and Business Administration: H. H. Davis, Arthur B. Moehlman, Paul R. Mort, Ward G. Reeder, and Alfred D. Simpson, *Chairman*; with the cooperation of B. R. Ford, Lloyd Morey, and A. W. Schmidt.

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FOREWORD

This number follows the same general plan as the corresponding number of the first cycle of the *Review of Educational Research*, published in April, 1932. Two chapters of the earlier review, "Public Relations," and "Fiscal Control and Textbooks in Business Management of the Schools," are omitted. No studies have been found on the first topic, and the second is included in other chapters. New chapters are included on "Capital Outlay, Indebtedness, and Debt Service," and on "Public Education Costs."

In view of the urgent nature of the financial problems during the depression and the readjustments in expenditures entailed by curtailed income, a review of the studies in this field is especially useful at this time. The exploration of sources of revenue, the study of organization and administration as related to economy, and the problem of meeting the changed conditions without lowering the quality of educational practice and outcome, engage the thought of school administrators to a greater degree than in quieter times. This issue will serve its purpose if it helps administrators clarify their problems of finance and management, and if, in addition, it stimulates further research on problems which have thus far not been sufficiently illuminated.

FRANK N. FREEMAN,
Chairman of the Editorial Board.

INTRODUCTION

This number for the most part limits its review of research in the field of educational finance and business administration to the period since April, 1932, when a similar issue appeared in the first cycle of the *Review of Educational Research*. Occasionally, however, references have been made to studies prior to 1932. It will be noted further that this number of the *Review* has for the most part refrained from dealing with fiscal matters relating to the teaching personnel, to school buildings and grounds, and to the legal bases of education. This is due to the fact that other committees of the Association were appointed to prepare entire numbers dealing with these problems.

Slight changes will be noted in the topical arrangement from that which prevailed in the first cycle number. The individual members of the committee have been given complete freedom in the choice of studies to be reviewed and in their treatment of the material.

Reference should be made here to the bibliography by Alexander and Covert (28), the most comprehensive and satisfactory bibliography on educational finance which has been prepared since the time of the Educational Finance Inquiry Commission.

In the original plan for this issue it was intended to have a chapter dealing with public relations with special emphasis upon their fiscal aspects. The member of the committee to whom this subject was assigned was obliged to report that during the period under consideration there had been no studies which could be characterized as research in the field of public relations. The only reason for commenting upon this fact at the present time is to draw attention to the importance of this area as a fertile field for research. The problem of public relations and particularly the relationship between school and other governmental finance is one deserving of much more attention than it receives.

In 1931 provision was made by the Congress of the United States for the National Survey of School Finance. The appropriation act made available $50,000 for the first year of what was planned to be a four-year undertaking. No project in the field of educational finance promised more than this national survey. Our great expectations were fully substantiated by the first three studies which appeared and which are reviewed herein. No one familiar with the school finance situation or with the research in this field can fail to be dismayed by the abrupt curtailment of the National Survey after the first year of its life. It is particularly disconcerting that in a period such as the past five years it should have been found necessary to halt this undertaking. It is to be earnestly hoped that this project may be resumed and that the further researches which were planned at the inception of the survey may be continued under federal subsidy.

Finally, I wish to express my appreciation to the members of the committee appointed to prepare this number and to others who have assisted for their cooperation and contributions, rendered in most cases, I am sure, in the face of insistent pressure from the demands of their regular work.

Alfred D. Simpson, *Chairman,*
Committee on Finance and Business Administration.

CHAPTER I

Public School Accounting

THE initial reporting of research in public school accounting for the *Review of Educational Research* in April, 1932, included a general review of tendencies up to November, 1931. At that time the schools were just beginning to feel the depression seriously and emphasis was quickly directed to more pressing problems than those of the technical keeping of books for income and expenditures. Questions of taxation, revenue, organization, administration, planning, and budgeting occupied the major attention of specialists in this field. As stated in the first report the term "research" must be used rather broadly in reporting studies on accounting. Some of the material represents experience, and other subjects include generalizations developed either from observation or from hunch. Considerable latitude, therefore, has been employed in reporting studies.

Raw Cost Appraisal

The danger of using raw costs in educational accounting as a means of measuring relative efficiency of instruction was pointed out by Frostic, Lovejoy, and Erickson (6). They emphasized the fact that the analogy between commercial and public accounting, so frequently assumed as complete by both business man and superintendent, is scarcely tenable. Careful study was made of only forty-nine of the variables in public school accounting. These variables were traced and their differences analyzed in a number of communities. So marked were these differences that the authors concluded that "the practice of executives and boards of education to justify school efficiency on the basis of low tax rates or low per capita costs, without regard to the service rendered, is not only reprehensible but pernicious."

State Systems

After several years of research on a laboratory basis at the University of Iowa under the direction of Professor E. T. Peterson, in certain problems pertinent to a uniform state accounting system, a general plan was worked out by Williams (12) and was designated in 1934 by the State Department of Public Instruction as the official accounting system for all Iowa public schools. Authority for its promulgation was derived from two statutes enacted in 1933 which (a) made the State Department of Public Instruction responsible for devising an accounting system; and (b) provided that the state auditor should arrange for an annual examination of the financial condition and transactions of all school officers. The study includes essential records and descriptions governing their use, unit costs and suggestions for their derivation, lists of equipments and supplies, duties of the secretary and of the treasurer under the law, a working bibliography, and illustrations of accounting forms.

Accounting Procedure and Principles

Fowlkes (5) published an expansion and improvement of his earlier study of financial accounting. The system, subjected to field experimentation for three years, draws its inspiration chiefly from Hiram Case. The author also admits the influence of nine other writers in this field. It is designed as a complete system of commercial accounting and promoted as such.

Morrison (10) pointed out the differences between the financial concepts involved in business and those involved in educational administration. His concept is that capital invested in the school plant must yield valid returns. These returns are interpreted through the values that education creates which he lists as: (a) utilization of productive capacity; (b) improvement of the demand for necessities and luxuries; (c) development of increased purchasing power; (d) development of thrift; (e) population control; (f) expansion of the professional vocations; and (g) growth in economic intelligence. Wehn (11) raised again the three bases for public school accounting: accrual; income and expenditure; and cash. After some evaluation he concluded that the best basis for public school accounting is income and expenditure. Hanley (7) supported the badly exploded assumptions of the "imputed economic costs" theory in public accounting by drawing a direct analogy between public and commercial accounting. He recommended the inclusion of depreciation in determination of per capita raw costs. Since the opposite point of view (depreciation as a continuing element satisfied through upkeep) has even been presented seriously by the railroads to the Interstate Commerce Commission as a valid reason for the diminution of their depreciation reserves, Hanley's analogic assumptions do not appear to have great validity even by presumption.

Administration

Beach (1) classified and described the different forms of custody of school funds in the various states. After appraising the custodial aspect of revenue practices on the basis of safety, economy, responsibility, adequacy, simplicity, readiness for audit, and selection of personnel, he concluded that the depository system now in use in four states is far superior to the schoolboard treasurer system in nineteen states; the schoolboard clerk-treasurer system in five states; and the governmental treasurer system in twenty-three states. Brunstetter (2) made a study of certain aspects of fiscal procedure in nine New Jersey cities. While much of his investigation was concerned with the actual accounting, no recommendations were made with respect to this activity. He did, however, recommend that the superintendent be made the chief executive of the board.

Dienst (4) studied the administration of endowments with special reference to the public schools and institutional trusts of Idaho, including their administration, accounting, and investment. He found that "endowment accounting is practically restricted to the making of documentary records and single entry bookkeeping. . . . The classification of accounts is confused and incomplete. . . ." Although a definite part of the state administrative program, there was neither unity nor plan for adequate fiscal management. General recommendations for improvement are made.

Internal Accounting

Reports on internal or non-public revenue accounting are limited to three, none of which makes any contribution to method. Kitson (8) described an internal system in connection with a school store and supply department. He reflected the commercial influence. His emphasis was on forms and their use. Miller (9) discussed the need for centralization of all intraschool organization funds into a single fund under faculty control. He described the organization and operation of such a plan in a secondary school. Carey (3) outlined the method used to place extracurriculum activities of the Beatrice, Nebraska, junior and senior high school on a sound financial basis. He developed three factors deemed essential: (a) democratic participation in control; (b) centralization of management; and (c) the creation of one fund for a balanced program.

CHAPTER II

Public School Budgeting

Comparatively little advance in budget technic has been made since the first reporting of literature in this series. Emphasis since 1932 has been upon the need for budgeting and the developments of refinements in the technic of budget building.

Principles

Simpson (27) considered the budget functionally and defined it as "the financial plan for the enterprise or function of education during a given period." The budget is a tool, a means, an instrument which introduces orderliness in the financial processes for the purpose of advancing the educational welfare of the children. The budget must, therefore, be a facilitating control designed "to smooth and render orderly" the administration and the progress of the schools. A good budget should be an evolutionary process which constantly approaches even though it never attains perfection. This involves a number of important factors, including particularly (a) a careful determination of the relative values of the various elements of the educational program, and (b) a consideration of each budget as a link in a process of long-term financial planning.

Simpson stressed particularly the importance of the appropriation act by the board of education or other governmental authority whereby the budget is put into effect. The appropriating act should be clear cut, so worded that its interpretation is unmistakable, and should be legally recorded in the proceedings of the appropriating body.

Since a perfect budget cannot be developed, provision must be made for revision and transfer of items in event of unforeseen conditions after the budget has been adopted. The control of revision or transfer should rest in the board of education, but should be exercised only on recommendation of the superintendent. Simpson discussed two methods by which revision may be made: (a) formal rate of transfer, and (b) use of the allotment system. He favored the former for small school districts and pointed out certain advantages in the latter for large city systems. He also discussed the value of recording encumbrances, showed how it helps to interrelate budget administration and accounting, and strongly advocated its use.

Morrison (22) described and analyzed the fundamental essentials of an adequate accounting system. He presented a budget form that may be used as a guide in developing budgets. He reflected the functional point of view in the administration of public school finance. Pratt (25) advocated six ways of improving the financing of public education. The last three are concerned with budget. He stressed the importance of budgetary control

The expenditures cover:

1. Cost of bond issue
2. Educational survey and consultation
3. Purchase of site
4. Surveying the site and making test drillings
5. Educational equipment
6. Building or construction contract
7. Architect's fees
8. Athletic field, playground, and landscaping
9. Special services, such as building inspector, insurance, janitorial service before building is completed, and other miscellaneous items.

Jones (20) listed the sources of income, in addition to bond sales, which are frequently overlooked in developing the building budget. He also listed items of expenditures which frequently escape notice until the last minute.

Depression Budgets

Guy (19) described on the basis of a survey of 197 school systems how school officials have readjusted budgets to meet reductions in income. Included are economies in administration, supervision, personnel, supplies, and curriculum services. He pointed out the dangers that are likely to result from decreased efficiency.

Appraisal

Seyfried (26) made a study of budgetary practices in 128 school systems of New Mexico from the results of a questionnaire study. He then attempted to see how well these practices conform to the recommendations of authorities in educational administration. His findings were that (a) school financial matters in New Mexico are largely in the control of non-educational boards; (b) educational needs must therefore be determined mainly on the basis of arbitrary rules according to inexpert opinion; (c) a majority of the superintendents favor the present plan of budgetary procedure; and (d) there is sufficient opposition to the prevailing plan to indicate that changes are needed.

CHAPTER III

Revenues and Taxation

During the period covered by this review, there has been a continued increase in the amount of factual information as well as of periodical literature dealing with the subject of revenues and taxation. This suggests a continuation of the increase in realization by school people of the fundamental importance of school support in its entire social and economic setting. The conditions of financial support of schools over the period covered in this issue of the *Review of Educational Research* have been of particular significance from the standpoint of lending opportunities to the research worker for study of the traditional mechanisms under the stress of worldwide economic chaos.

The Critical Issue of Adequate School Support

Following forced retrenchments which came throughout the country in the early part of 1931 and later, a great amount of attention of school authorities has been given to the matter of need for providing all schools of the United States with ample and adequate revenues. There have been a number of general treatments of this matter. A report of the National Education Association (96) dealt with the recent reduction in school revenue, discussed the relationship between school finance and municipal finance, treated the matter of tax relief and tax reform, and took up the issue of the optimum size of local units for purposes of rural school finance. Reusser (112) narrowed the crisis to a problem primarily of taxation. The Citizens Conference on the Crisis in Education (41) attributed school fund retrenchments essentially to tax delinquency, lowered assessments, declining tax rates, and bank failures. Norton (106) studied the effects of the depression on the support of education in the United States and attributed obsolescence in traditional methods of taxation to the increase in variety of forms of tax-paying ability, greater inequality in the distribution of wealth, and the instability of local revenue sources because of economic specialization. He proposed the reorganization of school administrative units and the assumption of greater responsibility by both state and federal governments for raising school revenues.

Authoritative thinking has shown the need for further reorganization of state taxing systems because of (a) the statewide nature of the administration of newer types of taxes (37, 63, 65, 68, 71); (b) the continued excessive burden placed upon the property tax; and (c) the need for its relief so as to provide tax leeway by which local communities may exercise local initiative (46, 88, 89, 90, 92, 93).

A number of students of the problem of revenue and taxation for schools have considered with care the fundamental principles of taxation per se. The National Tax Association (102) set forth and developed a practical application of the following principles:

1. Every person having taxable ability should pay some sort of direct personal tax to the government under which he is domiciled and from which he receives the personal benefits that government confers.
2. Tangible property, by whomsoever owned, should be taxed by the jurisdiction in which it is located, because it there receives protection and other governmental benefits and services.
3. Business carried on for profit in any locality should be taxed for the benefits it receives.

Among the general publications, which took up the matter of taxation from the standpoint of its importance to public education in particular, have been studies made by Lutz and Carr (82) and Mort and Lawler (95). The Joint Commission on the Emergency in Education (71), through conferences of school administrators, pointed out the need of developing a balanced system of taxation; of distributing the tax more equitably; of discontinuing dependence for school support on the property tax or any single revenue source; of transferring a larger part of support from local to state governments; and of developing more effective tax administration and collection systems. This Commission also made recommendations for state and local governments as to devices to be considered and matters of expediency during the depression.

Tax delinquency and local school revenue—Bird (30), in a study of fifty representative cities, found the average delinquency 10 percent in 1929, 16 percent in 1931, and 19 percent in 1932. In some communities the proportion of delinquency had approached 50 percent. Others have agreed with Haig (65) that the current situation of lack of adequate school revenue has more fundamental causes than the mere shortcomings of the revenue system, and that the amount of revenue for schools and school purposes in the United States as a whole is quite directly correlated with its economic source.

With curtailment of revenues from local sources and the crisis in local school support, an increasing number of students of school finance have come to the appreciation of the shortcomings and abuses of the property tax in the United States. The National Survey of School Finance (127) pointed out that closer association was needed between school support and the entire social basis for education. Carr (37) showed that several states had entirely given up the property tax as a source of state public revenue, and that public education in the future will demand an increased amount of our social income, provided either through additional public revenues, or through the use of funds now spent for other functions.

Attempts have been made to measure the improvement of school systems as they are related to improvements in financial support. Such studies were undertaken in Delaware by Daugherty (45) and in New Jersey and Maine by Mort (89, 92).

Tax relief and equalization—One of the remedies for the difficult fiscal situation through which the schools have gone during this period has been the equalization of educational opportunities through increased state support as a means of property tax relief. The extent of equalization in the United States was summarized by Mort and his associates (93) in the National Survey of School Finance which made a comparison of sources of school revenue from state and local governmental units as well as the extent of equalization in each of these states.

Pitkin (110) found that during previous depression periods, when owners of real estate had resisted the pressure of property taxation, new sources of revenue had been found, and that increased activity toward equalization of the tax burden and providing equal educational opportunity had existed then as now.

Great attention has been given of late to the use of state aid as a device for relieving inequitable conditions of taxation. The tendency towards complete state support of a foundation program is found in such plans as those recently put into operation in Indiana, West Virginia, North Carolina, and Ohio. When taken together with the tendencies in this direction in California, New York, South Carolina, and Maryland, it may be of considerable significance as a departure from the strict small fund equalization basis. This tendency has been confusing to many persons who have had in mind simply the equalization of burden among communities. The newer studies of state school revenue systems have treated this problem rather extensively. Particular reference may be given to the work of Mort in this direction, assisted by Davis in Ohio (88) and Lutz in New Jersey (92) and Maine (89).

Dreesen (49) concluded that in Oregon, equalization of school tax burden had been obtained with but partial, if not questionable, success. Of the funds raised in that state under the state school fund law, 85 percent finds its way back into the very districts from which it was produced. Mort, Simpson, and others (94), in a survey of the effects of equalization in New York state, found a tendency for poorer districts to devote more of the new aid to tax relief and less to educational needs, and for the wealthier districts to devote more to educational needs and less to tax relief thruout the four years from 1926 to 1930. Staffelbach (119) studied the extent of the reduction of taxation for schools and compared the reduction in support of schools with the reduction in taxation for the support of other governmental enterprises in California.

Trends in More Adequate Provisions of School Revenue

There have been several general treatments of trends in possible future developments of sources of revenue for the support of public education. Carr (37) suggested that the trend of giving up the property tax as a major source of state public revenue will probably continue. He anticipates a greater assumption of responsibility for school costs by state and federal governments. This will involve the use of new state taxes which will relieve the local property tax burden. An extensive review of taxation in the United States since 1913 was made by the President's Research Committee on Social Trends (68).

Sources of school revenue other than taxation—Odell (107) found that private contributions to elementary and secondary education more than doubled from 1927 to 1929, and that the percent of total philanthropy favoring education increased from 8.4 percent to 19 percent. He concluded that if endowments do not exceed an amount which will provide less than a sufficient income for meeting the entire cost of public education in a community, the local citizens will, through tax reduction, make sure that a disproportionate sum is not expended on education.

Dienst (48) pointed out the need of new legislation and control for the administration of endowments. A summary of technics for the protection of school incomes with reference to practices in collection of taxes, assessing property, collection of tuition, and incomes from rentals, fines, and other sources, was made by Linn (80).

Legal aspects of providing school revenue—In addition to summaries of taxation in school revenue legislation which may be found in regular government sources and in such compilations as that of the Tax Research Foundation (122), several studies have brought together legislative provisions for school support in the states. In the National Survey of School Finance (93), tabulations were made showing the sources of revenue in general, and of education in particular, from 1925 to 1930, for each state and for the United States as a whole. The National Education Association (99) found that the number of states taxing personal income and the number of states taxing corporation incomes more than doubled in the period from 1928 to 1933. In 1933 the number of states levying general sales taxes more than doubled. There were two states with chain store taxes in 1928 and nineteen in 1933, and a slight increase for the same period in the number of states taxing tobacco sales.

Yakel (132) studied court cases relating to properties which are subject to taxation, the purposes of taxation for schools, the matter of tax levying, its control, and the rights and remedies of taxpayers. A similar study was made by Garber (59) who showed, in addition, that courts agree that school taxes are not local or municipal taxes in any sense. For the year 1933 Keesecker (73) found that at least twelve states (California, Idaho, Indiana, Minnesota, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, South Carolina, Washington, and West Virginia) assumed increased responsibility for public school support.

Coordination of sources by governmental units—There is increased recognition of the need for coordination of tax administration. Heer (68) showed that this is true essentially because (a) non-property taxes must be shared with the federal government; (b) the applications of income or business taxes operate in more than one state; (c) the development of taxes to supplement those on property arises from wide differences in systems in various states; and (d) newer taxes are, with few exceptions, uniform statewide taxes administered by state agencies. This problem has been studied in greater detail by Haig, who is now working on a publication which should be of great assistance to those encountering the issues arising out of tax reform measures (63). An analysis of the integration problem in Germany has been prepared under his direction by Wueller (131).

Evidence of the need of coordination of the various tax systems, particularly during the depression, when certain sources, such as the property tax, are subject to heavy burdens, may be found in a report of the House Committee on Ways and Means (126). In a study of cities over 10,000 in population, Foster (54) found 14 percent of city revenue coming from the state, 5 percent from the county, and 0.2 percent from the federal government. He found a decrease in general property tax for current expenses of 5 percent, but for debt service an increase of 3.7 percent.

The National Education Association (99) found a growing tendency to dedicate tax revenues for state school support (see Table 1). Pearman (109), however, reported that for the decade ending in 1930 in the United States as a whole, the proportion of dedicated tax revenues to total revenues had decreased and that there were noticeable tendencies toward increased reliance upon general revenue appropriations.

Pearman claimed the necessity for the dedication policy for the preservation of financial support during periods of economic stress, because of the fact that the general revenue appropriations do not offer to schools the security that the dedicated tax revenue seems to provide. He proposed that especially when a state has adopted a plan of distribution based on satisfactory and objective measures of need, the general revenue policy is preferable. Both approaches to this problem were studied in the National Survey of School Finance (93) which, in addition, pointed out the advantages of the "overflowing pot" plan, which provides for the dedication of the first returns of a given tax, the yield of which is larger than necessary to finance the desired program. This is the plan typified by practice in Massachusetts.

The studies of Proctor (111) and Little (81) attack the problem of the reorganization of administrative units and concur in the belief that consolidation would mean potential reduction in school costs and more even spread of the tax burden. The United States Office of Education (47) studied school administrative units and reported the extent to which the general property tax is used in connection with the county as a unit in school financial administration.

Taxation

The most complete information concerning the status of taxation in the various states and of countries other than the United States has been prepared by the Tax Research Foundation (121, 122). In the latest of these publications may be found charts of all important tax systems of the world, synopses of taxation for all important jurisdictions, and charts of tax systems recommended by authorities and by various interest groups. Summaries of state and federal taxation for school purposes have been presented in popular form by Brant (32) and Davis (46). In addition to the general comprehensive sources of information (33, 34, 35, 56, 62, 74, 83, 87, 124), special and detailed studies of taxation are outlined below.

TABLE 1.—SCHOOL REVENUE OTHER THAN PROPERTY TAX, 1931 AND 1933, AFTER THE NATIONAL EDUCATION ASSOCIATION (99)

Type of tax	Number of states levying		Number of states allocating all or part to public education		Number of states in which tax contributes to education indirectly through significant appropriations from the general funds	
	1931	1933	1931	1933	1931	1933
Personal income	18	24	6	11	9	10
Corporation income..	20	26	4	8	12	14
General sales	7	17	0	7	6	9
Chain store	10	19	2	9	4	7
Tobacco sales	13	16	5	6	5	6

The property tax—King (75) found twenty-one of the thirty-two states which have earmarked amounts of state revenue for education resorting to the property tax method. Fowlkes and Peterson (55), in investigating the occupational distribution of individuals paying a real estate tax in Madison and Dane Counties, Wisconsin, found that taxes in the state bore little or no relation to ability to pay. Heer (68) reported that the country as a whole has made no conspicuous progress away from the general property tax during the period 1910-30, but that some leadership has been evidenced in certain states. Delaware in particular decreased its load on the general property tax by 56 percent from 1913 to 1930. Among the eighteen states which showed a decrease in general property tax burden there was a great disparity as regards the other sources of special taxation. Efforts have been made in some regions to correct errors in previous methods of property taxation by (a) distinguishing between the various kinds of property, and (b) introducing the principle of differential effective rates.

In a study of the distribution of public utilities valuation in connection with revenue for public school systems in the state of Washington, Gaiser (58) found that such distribution was unequal in spite of the fact that the services of public utilities corporations are uniformly used. He developed this as an argument for removing utilities taxes from local jurisdictions and subjecting these corporations to uniform statewide taxes. Vaughan (128) made a critique of methods prescribed by law in Missouri for determining rates of taxation on property of public utilities for school revenue, finding that such methods were inequitable in that state.

Fuller (57) found that a majority of courts hold that public school property actually used for school purposes may not be assessed for local improvements. Courts of all states refuse to permit special assessment of school lands granted to states by Congress in absence of any specific provisions permitting such action.

Legislation limiting the rates of local property taxation for school purposes was reviewed by the National Survey of School Finance (93). Leet and Paige (78) discussed the growth of tax limitation laws and evaluated provisions in Illinois, Indiana, Iowa, Kansas, Michigan, Ohio, Washington, and West Virginia. Constitutional limitations have also been studied by Lentz (79).

Income taxes—A rather complete study of the state income tax by Blakey and others (31) dealt with various features of state income taxes, their administration, their operations, and effects. He applied the findings in particular to the state of Minnesota. Martin (85) showed how yields from personal income taxes are distributed with the possibility in view of utilizing federal personal and corporation income taxes for the support of education. Goldthorpe (60) analyzed the possible incidence of such taxation.

The National Education Association (98) summarized the present use of the corporation income tax as a source of school revenue in the United States for the year 1931, and discussed the relation of its yield to school costs, showing the amounts of collection for such revenue and receipts from other sources. Ford (53) studied the allocation of corporate income for the purpose of state taxation.

Sales taxes—The most complete study of sales taxes during this period was made by Haig and Shoup (64). They treated the general sales tax from a historical standpoint, a legal standpoint, and as a state fiscal measure, giving outlines of its utilization in the several states, and the reactions of taxpayers to its use. The National Industrial Conference Board (100) treated the general sales tax as to yield, administration, relation to income taxes, and incidence. Carpenter (36) reported that this tax was rapidly spreading, and found that up to November 1, 1933, twenty-two states had legislation providing for taxes which might be classified as sales taxes. His study reported the dates of original enactment and subsequent modification.

Individual state and local studies—Comprehensive tabulations of the arrangements of tax systems in all of the states of the Union have been made (93, 119, 121). The National Education Association (99) summarized legislation concerning state tax surveys and commissions during the period 1929 to 1933. Studies are in progress by Mort (91) and Chism (40) which estimate potential yields of taxes in various states under theoretically ideal and practically possible tax plans for the purpose of determining the relative ability of states to support public education. Mort's investigations have been undertaken as one step in determining satisfactory measures for possible distribution of federal revenues to the several states. Chism's investigations look toward the refinement of Norton's measures of the relative ability of states to support education.

Various aspects of the tax situation in individual states have been studied in:

Arizona (76)
California (42, 50, 119)
Delaware (44, 45)
Idaho (48)
Indiana (84)
Kansas (70, 104, 130)
Maine (89)
Maryland (43, 86)
Minnesota (31)
Missouri (66)
New Jersey (92)
New Mexico (117)
New York (94, 103, 113, 115, 118)
Ohio (52, 88)
Oregon (49)
Pennsylvania (105)
Tennessee (123)
Utah (39)
Virginia (116)
Washington (58)

During the period there have been a large number of investigations of specific localities undertaken by students as theses for master's degrees. These are listed in the bibliography prepared by the United States Office of Education (61). Swift (120) has shown a continued interest in research dealing with the modes of financing education in other countries.

CHAPTER IV

Research and Survey Technics

SINCE methods of research in school finance were discussed in a previous issue of the *Review of Educational Research* (138), any exhaustive treatment here would be out of place. There are, however, a few areas which, because so much effort has been directed toward finding or improving technics, merit special attention.

Salary Schedules

The first of these areas has to do with salary schedules. Changes in living costs and cutting of salaries have forced increased attention toward determining proper salaries for teachers. It is increasingly evident that the commonly used indexes of wages and living costs do not fit teachers very well, because of their necessarily higher living standards.

Eells (134) studied expenditures of teachers in Fresno, California, and showed that their apportionment of living cost differs widely from the standard of the United States Bureau of Labor Statistics. Since the items which are heavily weighted by the Bureau, particularly food, have had a larger decline in price than have other items which are less heavily weighted, such as insurance, the decline in living indexes, as shown by the Bureau of Labor Statistics, is larger than it should be for teachers. By reallocating the money in terms of teachers' standards of living, Eells found that the cost of living index should be 27.2 percent higher than that compiled by the Bureau of Labor.

Rutledge and Huntington (139) took a slightly different approach. They set up "quantity and cost estimates" as a basis for determining adequate salary standards. They established careful estimates of the amount and quality of each kind of goods needed by teachers with various numbers of dependents. They claimed that these estimates are better than actual records, since the records are varied at times by unusual conditions, such as sickness.

Teachers are primarily interested in the amount of individual salaries, but the school district must also consider the total cost of all the salaries. Elsbree (135) has added greatly to the accuracy of estimates for the cost of salary schedules by his technics. He has five major steps:

1. Subtract the turnover.
2. Move the remaining teachers to the next year's step on the schedule.
3. Add the replacements at the most probable place on the schedule where replacements will be located.
4. Add the new staff members necessary to take care of growth in the system, again at the most probable point on the schedule at which they will be placed.
5. Sum the cost.

The technic is very carefully worked out and includes predictions of changes in position on the schedule due to added training.

Equalization of Educational Opportunity

It is also natural that much attention should be directed during these years toward developing important ways of providing equalization of educational opportunity. Mort (137) continued his work of perfecting technics for state equalization and has recently given attention to the federal problem. He presented alternative technics, one using average daily attendance data, the other using census data. He has computed a cost differential between high-school and elementary-school pupils, and a differential to increase amounts needed in rural areas, the latter increasing with sparsity of population. Indexes of cost of living for each state are also provided.

Cocking (140) found, after trying several criteria, that density of population serves as an effective basis for varying state aid allotments so as to care for varying abilities among the school districts of Tennessee. For purposes of distributing state aid the sparsely populated counties are allowed relatively more teaching positions than the more densely populated counties. His use of the word "ability" is somewhat broader than that commonly applied, but the additional meaning seems to carry much merit. It is no doubt true that the ability to do the thing which needs to be done is more important than mere ability. The ability to educate a few children scattered over a wide area means more in terms of money than the ability to educate the same number of pupils living close together.

Unit Costs

Because reductions in budgets are the order of the day it has seemed important to know more about unit costs so as to be able to estimate as accurately as possible the financial result of removing parts of the program. Moehlman (136) dealt with advantages and disadvantages of architects' units of measurement and found that "physical envelope efficiency" is the best of these measures. This he defined as "the number of cubic feet of building secured for every square foot of shell area." He pointed out that educational measures must go somewhat further than architects' measures, and added to the measure given above, the factor of the ratio of instructional area to total area in the building. When this factor is multiplied by the physical envelope efficiency, an excellent unit is obtained.

Davis (133) sought to develop a basis of calculating costs of high-school subjects that would show variation due to cost of plant, supplies, and other items besides teachers' salaries. As a result of using a new technic, he showed that teachers' salaries do not necessarily vary directly with all other costs as some studies have implied. In two subjects, the teachers' salary cost may be the same, but total cost may differ widely.

CHAPTER V

Capital Outlay, Indebtedness, and Debt Service

Because of the unusual financial and banking situation which obtained during the period covered by this issue of the *Review of Educational Research*, debt and capital outlay problems appear in somewhat distorted form. Expenditures for capital outlay, except with federal aid, and issuance of new bonds for purposes other than financing of relief were at a low ebb. Bond refunding, and new limits on the issuance of bonds attracted unusual attention.

Interest rates and prices of bonds have gyrated wildly, but since the day-to-day research on such matters is covered adequately and continually in such publications as the *Daily Bond Buyer* or the *Commercial and Financial Chronicle*, these matters need no treatment here. Neither is it necessary to attempt a complete bibliography, since the *Education Index*, the *Bibliography of Research Studies in Education* issued annually by the United States Office of Education, and other reliable sources serve that purpose adequately.

The old battle of bonding versus pay-as-you-go is still going on. An excellent treatment of the present status of the struggle was provided by Essex (144). He reviewed other studies and showed in his own work that each of the two plans has advantages, at least under present conditions. Bonding is more uniformly feasible because a small district can thereby scatter the cost of erecting a building over a period of years. Essex suggested the desirability of cooperation among districts so as to gain the financial advantages of the pay-as-you-go plan without the disadvantage of enormous taxes over a short period. Possibly something on the order of a building and loan association for school districts would serve. He pointed out the need for further research to determine the value of money to the taxpayer. This is crucial and determines whether or not it is better to leave the money with the taxpayer over a period of years and borrow as a community, or to take the taxpayer's money and avoid community borrowing. Eells (143) added some concrete evidence from Fresno, California, when he showed how that city spent four and one-half million dollars to buy two million dollars' worth of buildings. The reason, of course, lies in the interest paid on its 5 percent bond issue of 1919-54. Cowen (142) presented all three for financing capital outlays. Partly by means of excellent charts and tables he showed the advantages and disadvantages of the reserve fund, the bonding, and the pay-as-you-go methods. He pointed out that the advantage in terms of tax paid is in favor of the reserve fund, but that pay-as-you-go leaves the money with the taxpayer until needed. The study is a good one, but further emphasis on the danger of loss or misappropriation of reserve funds would be desirable.

Those concerned with school or municipal bonds watch the trend of the relationship of bonded debt to property and to population. Two representative studies on this matter are by Rightor (149) and by Holy (146). Rightor found that bonded indebtedness of 289 cities rose from $109.04 per capita in 1931 to $114 in 1932. For 73 comparable cities over 100,000 population the per capita figures were $92.84, $100.66, $106.65, and $113.97, respectively, for the years 1929-32. Holy found that the school bonded debt per pupil in cities of Ohio dropped from $222 in 1933 to $208 in 1934. Holy's study also threw light on the refunding problem and showed that the cities concerned refunded $2,523,278 of bonds in 1934 as compared with $2,301,619 in 1933. Since we learn from the same study that these cities had outstanding school bonds of $146,635,000 the amount refunded was less than 2 percent of the total. Chatters and others (141) dealt with the even more crucial question of municipal debt defaults and provided information designed to be helpful to officials and citizens as well as bondholders. He discussed particularly ways and means of safeguarding municipal bonds and avoiding default.

The issuing of bonds and the limitations upon such issuance have also been studied. Hill (145) showed how a bond issue may be carried in these difficult days and provided ideas which might be used by other superintendents. Keyworth (147) analyzed court decisions of 1932 on bond-issuing power of boards. Pierce (148) presented information concerning new limitations on bond voting, showing that ten states have by statute or constitutional amendment restricted voting on local bond issues to property owners. This tendency deserves careful attention from all school people, since it reopens a question which had formerly been regarded as settled.

CHAPTER VI

Finance and Business Administration in Institutions of Higher Education

THE increased attention given to the intensive study of problems relating to finance and business management in the field of higher education during the past two years is evidenced by the amount of publication dealing with that subject. One monthly periodical, the *Educational Business Manager and Buyer*, devotes its space entirely to the general subject of finance and business management and chiefly to the field of higher education. The various bulletins and the final report of the National Committee on Standard Reports for Institutions of Higher Education (183, 184) have made a significant contribution to the study of procedure. The various academic periodicals have all carried some material relating to higher education finance as have the various accounting journals. Bulletins from the United States Office of Education and from the foundations and associations have further augmented the list.

Interest in this subject during the past biennium has been centered largely upon (a) economy, (b) procedure, and (c) statistics. The literature of the period, however, has included a number of noteworthy discussions on sundry topics, some of which have not received previous attention.

Economy

The financial conditions faced by the colleges and universities, became particularly pressing during 1931. They resulted in several important contributions to the problem of budgetary readjustment. A comprehensive analysis of this problem was presented by Christensen (155, 156). Constructive proposals were also offered by Compton (157), Maclean and others (176), Cummins (158), Daines (159), Rainey (189), Russell (195), S. W. Smith (199), Sproul (200), and Woodmore (208). A highly serviceable study of the matter with relation to the moderate-sized college was presented by R. L. Kelly (173). A large-scale review of the whole problem, with important recommendations, both with respect to the emergency conditions and to long-range considerations, was presented by Hill, F. J. Kelly, and Savage (170).

All of these studies emphasize the importance of an intelligent, thoroughgoing analysis of academic procedures in relation to budget resources. The necessity of such an analysis has been intensified by the budget limitations of this period. Its value, however, is likely to be far-reaching and it is a program which should not be suspended, even though the emergency may pass. Several institutions have set up more or less permanent organizations in the form of statistical bureaus or faculty committees, through which a continuous review of all administrative and educational processes can be conducted. The emergency has called also for a search for ways of reducing costs of business administration and physical operation. A large part of the discussion of business officers and the literature dealing with their activities has to do with this subject. Notable among the contributions along this line may be mentioned those by Christensen (154), Franke (165), and C. E. Reeves (190). Christensen set forth some fundamental principles on which the business organization should be planned. Franke, who is one of the few public accountants who have interested themselves especially in problems of college and university administration, presented a discerning analysis of institutional business office problems from an independent point of view. The discussions by Reeves provide an unusually complete outline of problems to be met in physical plant matters and helpful methods of meeting them.

Purchasing received special attention by Dinsmore (162), Forbes (164), Gregg (169), Phillips (187), and Slater (197).

Problems of reduced income gave rise to considerable discussion of the question of determining the unit cost of instruction. Brown (152, 153), Hungate (171), Maclean (177), and Van Dyke (204) dealt with this subject. The National Committee on Standard Reports (183) issued a comprehensive review of the entire subject. The Committee also developed suggested plans for computing costs which, however, are offered as an auxiliary and optional matter. The Committee recognized the limited usefulness of such figures, and the extreme difficulties of unit cost comparisons between institutions.

The period under review brought forth some significant discussions of the technic of budget making, including a bulletin by the University of Denver (161) and discussions by Middlebrook (178) and Phillips (186). The North Central Association adopted during the period an important new program for accrediting institutions recognized by it, in which adequate methods of accounting and reporting play an essential part. The procedure prescribed by it with reference to financial administration, physical plant, and athletics is described by Russell (194).

Procedure

In the field of procedure an epochal study, relating to accounting and financial reporting, has been carried on by the National Committee on Standard Reports through the aid of the General Education Board and with the cooperation of the United States Office of Education and other bodies. This Committee devoted itself to the formulation of principles relating to financial reports and securing the acceptance thereof. Its suggestions have been put forth from time to time in the form of sundry bulletins (183) and articles in the various periodicals. Its material has been revised and reprinted (184). Several articles by Morey (179, 180, 181), the chairman of the Committee, and Franke (166) interpret and discuss the Committee's proposals. Aziere (150) made an interpretation of the proposals as they relate to Catholic institutions.

The recommendations of the Committee with respect to general accounting and reporting include:

1. The strict segregation of funds in accordance with their character
2. The classification of income and expenditures in accordance with a uniform plan.

The classification of funds adopted by the Committee is as follows: current funds, loan funds, endowment and other non-expendable funds, and plant funds. Current funds are subdivided into general or unrestricted funds and restricted funds. Funds subject to annuity agreements are accounted for as a distinct group in the endowment fund section. Funds of significant amount handled by an institution but belonging to others are to be set out separately as "agency funds."

The segregation of funds in this manner is considered by the Committee an essential to sound financial administration. Only in this way may funds that are earmarked for specific purposes be kept available for those purposes, and funds which are designated for endowment be kept inviolate of intentional or unintentional expenditure.

Classification of income and expenditures is based on the important segregation of expenditures for educational purposes from those for auxiliary activities such as residence halls, bookstore, and similar quasi-business undertakings. A uniform functional classification is suggested for the educational budget, the headings being:

1. Administration and general expense
2. Instruction
3. Organized research
4. Extension work
5. Libraries
6. Physical plant operation and maintenance.

The effects of the proposals of the Committee have been significant, even though those proposals have been before the higher educational world only for a little over two years. Already the principles advocated by the Committee have been adopted by the various church boards and by the North Central Association, as well as by several of the states. They have been endorsed by the various business officers associations and other educational bodies. The classifications have been followed by the United States Office of Education in its statistical reports. Great numbers of institutions of all sizes and types have already adopted the Committee's proposals either in detail or in substance. More progress toward general uniformity and a high level of excellence in the field of accounting and reporting has been achieved during the past few years than in all the previous history of college and university administration. It appears that the work of the Committee may stand for a considerable time as a standard of performance in this field.

Statistics

In the field of statistics a notable advance has been made by the United States Office of Education (203), which is the principal agency assuming responsibility for this subject. It has not only materially improved its reports, but has issued them much more promptly than in past years. The preliminary report for the year 1933-34, for example, was issued in the early fall of 1933. A more complete report, with estimates for 1934-35, was released in January, 1935, by Badger (151). A report on the land-grant colleges for 1934 by Greenleaf (168) was issued in November, 1934. Prompt publication of such material makes it of much greater service and interest to institutions.

The form and classification of the reports of the Office of Education likewise have shown marked improvement. This is partly due to the work of the National Committee on Standard Reports, there having been a close cooperation between the Office of Education and that Committee during this period. A period seems to have been reached in which the classifications will become more fixed and permanent. Through the acceptance of the suggestions of the Committee, institutions will likely have their own accounts and reports in form so that they can more readily compile the information requested by the Office of Education. In this way mutual benefits result, including greater ease to the institution and more promptness on the part of the Office of Education in bringing together and publishing the material and consequently greater satisfaction to those who use the statistics.

Other Studies

Among the college surveys made in the past two years, the one carried out at the University of Chicago by F. W. Reeves and others (191) gave particular attention to business organization and administration. A separate volume was published dealing with this phase of the survey in which a critical and constructive analysis of the relationship of the business staff of the University to the educational organization was presented. A brief statement of similar relationships in other institutions was also included. Although the study had to do with the University of Chicago, the volume is important for reference elsewhere. A significant phase is the recommendation that the office of comptroller be made independent of that of the office of business manager and relieved of responsibilty for direction of business activities, and that the comptroller's responsibilities be directed toward budgetary control, accounting, and financial reporting. The recommendation is further made that the comptroller have his primary responsibility directly to the board, but that, because of the necessity for close cooperation between the comptroller and the president, his appointment should be made by the board with the approval of the president.

A critical study of a problem which has been poorly understood and loosely administered was made by Wellck (206) on annuity agreements. The difficulties arising in the past out of failure to abide by sound principles are clearly set forth. An institution which follows the principles advocated in dealing with such funds will avoid pitfalls incident to them. It must be said, however, that if these principles had been universally followed in the past, the number of such gifts probably would be very greatly reduced.

A timely and comprehensive analysis of the problem of state support of public education was prepared by Mort and others (182). Stevens (201) also added to the discussion of this important subject.

The Teachers Insurance and Annuity Association (193, 202) published two important bulletins relating to the problem of faculty retirement systems. These bulletins set forth the salient features of existing systems and suggested essential principles on which the financing of retiring allowances should be based. A timely discussion of the relation of fraternity and sorority houses to institutional housing programs was presented by Dyche (163) and Watts (205) at the 1934 Midwest Business Officers meeting. A related subject, that of the taxation of educational institutions, was analyzed in a separate article by Dalgety (160).

CHAPTER VII

Public Education Costs

NEVER before has so much attention been directed toward the cost of education, and the number of studies on the subject has been increasingly large. For an extended list of such studies the reader is referred to the *Education Index* or the *Bibliography of Research Studies in Education* issued annually by the United States Office of Education. The research for the most part deals with comparative costs or with unit or per capita costs. Those studies which are made with a view to effecting an immediate economy are reviewed in Chapter VIII.

School Costs and Other Costs

Many studies have been made to show how school costs compare with expenditures for other purposes. Typical of such studies is that of the Research Division of the National Education Association (215). This study showed that the cost of public schools in 1930 took only 3.35 percent of the national income; that public education takes only 25 percent of the total tax dollar; and that for each dollar spent for education we spend five for the purchase and maintenance of passenger automobiles. Comparative costs for various other expenditures were also furnished. Another comparative cost study was made by Davis (210) in which school costs were compared with government costs in selected important cities and states. This study showed that current school costs took, on the average, only 20 percent of the public expenditures in eight large cities, and that teachers' salaries took only 12.9 percent. In six important states, teachers' salaries accounted for only 16 percent of the total state and local taxes. These figures demonstrate the fallacy of cutting teachers' salaries as an important means of tax reduction.

Comparative School Costs

Of the many studies comparing the costs of the same service in different schools, those by Fulmer (213) and Satterfield (217) are representative. The former dealt with South Carolina schools and showed the decline in daily teacher salary cost of all white elementary schools. This figure decreases in amount from $0.332 in one-teacher schools to $0.197 in eight-teacher schools. This decrease continues with increase in school size up to fifteen teachers. Larger schools show slight increases. The data for high schools tell much the same story. The study also furnished figures on the cost of transportation which are combined with the above data to show the net financial advantage of consolidation. Satterfield's study covered only Minnesota districts having a population of less than 5,000, and showed that the ratio of salaries to total current expense is greater in the larger schools and that the per pupil costs are larger in the smaller schools.

Comparative costs for the same services over a period of years are represented by such studies as that for New York City (219). This showed that the per capita cost in elementary schools dropped from $103.75 in 1932 to $97.21 in 1933, and that high-school and junior high-school costs declined in much the same way. Incidentally the study showed that for 1933, junior high-school costs were $116.36 per pupil and senior high-school costs $143.63 per pupil. Several other cities furnish excellent continuing figures through their annual reports. Notable among such reports are those for Boston, Pittsburgh, St. Louis, and Detroit.

The reports of the United States Office of Education have their usual valuable contributions. Notable among these is that by Comstock (220) which showed the distribution of current school cost among the usual items under which such costs are classified and the cost per pupil for the same items. This report showed that instruction received 78.4 percent of the current school dollar in 1933 compared with 77.4 percent in 1932. Operation gained from 9 percent to 10.6 percent for the period, while the proportion given to other expenses remained stationary or dropped. Eleven of the 297 cities included in the report show no decrease in per capita cost in 1933 from 1932. The rest show decreases ranging up to 41.7 percent. The cities are classified into groups according to size. Sixty-three and four-tenths percent of the cities over 100,000 population are covered by the report, but only 33.9 percent of those ranging from 30,000 to 99,999 are covered. For smaller cities the proportion included is too small to make the data of very much value. People who are interested in the cost of so-called fads and frills will find valuable information in addresses by Graham, Lake, and Warren (212), which give comparative costs for various types of school services in cities between the school years 1929-30 and 1932-33.

Unit Costs

Considerable attention has been directed toward unit cost studies because of the importance of knowing how to make budget cuts with maximum financial and minimum educational effect. Scates (218) pointed out some dangers in the use of these studies since they can be no better than the accounting system on which they are based. He also called attention to the fact that the basic function is not linear and that costs rise in a discrete manner somewhat like stairsteps. Ricksecker (216) studied salary cost per subject and found that English, social science, mathematics, commercial subjects, and physical education cost less than $10 per Carnegie unit, while foreign language, natural science, fine arts, household arts, and industrial arts cost more than that amount. Lowrey (214), in a per capita cost study of the schools of Fordson, Michigan, covering school years ending in the calendar years 1929-33, found that the costs were $165.73,

$147.42, $152.03, $140.39, and $198.67 respectively. Teachers' salaries account for 50 to 57 percent of these figures with the largest percent in the last year. Gooch (211) contributed to our information about costs in 6-3-3 schools as compared with 8-4 schools. By study of these in cities of more than 5,000 population in six eastern states he found that the per pupil costs for current expenses are about the same in grades 7-9 in the 6-3-3 type of school as in the 8-4 type; and that the costs in grades 7-9 are higher than those in grades K-6, irrespective of organization. He showed conclusively that the variation in cost is more a result of community ability or pride than type of organization. He found a correlation of .88 between expenditures in K-6 and 7-9 which indicates that the communities which spend liberally on their elementary grades below the seventh, also spend liberally on grades 7-9 regardless of the way in which they happen to be organized. Cornell (209) compared costs in high schools and elementary schools. His comparisons are based on data from thirty-three states and show the reasons for greater costs in high schools than in elementary schools. He provided ratios of costs in high school to elementary school for varying size of high schools. The ratio is lower in larger than in smaller schools and finally stabilized at 1.70 for high schools with average daily attendance above 675.

CHAPTER VIII

Financial Economy and School Business Administration

Since a forthcoming issue of the *Review of Educational Research* will be devoted to school buildings,[1] studies relating to the planning and construction of school buildings are omitted from the present issue; however, Chapter V of the present issue reviews studies on "Capital Outlay, Indebtedness, and Debt Service."

General Treatises on School Business Administration

Henzlik and others (240) contributed a small volume on practical economies in school administration. This work is an excellent summary of economies which various school systems have effected or which they might effect. It contains sixteen chapters on practical economies in such items as instruction, maintenance of the school plant, operation of the school plant, school organization, and auxiliary agencies. A similar book, recently published by Linn (250), is probably our most complete treatise on school economies. It suggests hundreds of practical school economies which might be effected. Cooper (229) also contributed a book on school economies. Although not as comprehensive as those just mentioned, it suggests hundreds of possible economies in education. Another general treatise on financial economy and school business administration is that by Morrison (258). In twenty chapters this book discusses such topics as the budget, terminal cost of education, depreciation, financial accounting, and teachers' salaries.

The Administrative Unit and Its Relation to Economies

During recent years many studies have indicated the large waste which results from the maintenance of small administrative units for schools. OBrien (262) pointed out that by centralizing elementary schools to secure an average enrolment of thirty-five pupils per teacher, and by combining small high-school districts to secure an enrolment of thirty pupils per teacher, $7,500,000 could be saved annually in the state of Kansas. Covert (230) presented data on economies which would result from enlarging the administrative unit for schools. He estimated that millions of dollars could be saved annually in the average state by adopting the county-unit plan, or a similar plan, of school organization. Cooper (229) analyzed cost in small school districts in various states, and compared those costs with costs in large school districts. He concluded that large administrative units were more economical. Turner (273) recommended the county unit for school administration instead of the small district or township unit which most states now have. He suggested four major economies which would accrue from the county unit. Bowman (223) compared school administrative units in Indiana with the units for other governmental purposes in that state. He made several suggestions for improving the status of the Indiana township and town school districts. He affirmed that the present school districts are too small for efficient administration. Waits (274) presented data showing that waste exists in the expenditure of school funds in Ohio due to the large number of school districts within the county. He stated that these local districts are too small for proper efficiency.

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[1] See also "School Buildings, Grounds, Equipment, Apparatus, and Supplies." *Review of Educational Research* 2:343-441; December, 1932.

School Organization and Instruction

Type of organization—Case (227) and Cooper (229) pointed out economies which would accrue from the platoon plan of school organization. Case outlined a platoon plan which would effect substantial financial economies and at the same time provide better educational facilities for the pupils. Cooper listed several communities in which the schools were platoonized. Pedagogical efficiency and financial economy were stressed as outcomes of this type of school organization.

Watrous (276) explained how Los Angeles reorganized its school administrative program. He stated that through this reorganization approximately $750,000 was saved. H. J. Miller (256) presented the views of the Minneapolis Taxpayers' Association relative to possible economies in junior high-school organization. In addition, he indicated economies which might be effected in teaching method, class size, and the curriculum.

Waltz (275) reported how a medium-sized school system effected an economy of $83,000. These economies were effected primarily in instructional services, janitorial services, office supplies, and school property repairs. It is interesting to observe that the economies were effected without reducing teachers' salaries.

Henzlik and others (240) pointed out many opportunities for economies in various types of school organization. Some of the factors which they stated should be given careful consideration were homerooms, semi-annual promotions, departmentalization of the elementary school, better organization for supervision, larger pupil-teacher ratios, alternation of subjects, and combination of classes.

Curriculum and teaching method—In a study of a large high school in California, McMillin (253) found that the hour period for class recitations was more economical than the forty-minute period. She also found that a six-period school day was more effective.

By means of lesson plans and tests prepared for classes in the social sciences, Squire (270) explained how economies might be effected. He stated that the teaching load could be approximately doubled; that small classes could be consolidated; and that a large amount of the pupils' time could be saved through more effective stimulation of the pupils.

Scott (267) gathered data from graduate students on possible economies in expenditures for instruction. From these data he concluded that school systems have by no means exhausted the opportunities for effecting desirable instructional economies. He pointed out several major opportunities for economies in instruction.

Spain (269) affirmed that the proposal of certain people to eliminate the use of school gymnasiums, play rooms, and auditoriums would be impracticable and wasteful. He made an analysis of the factors affecting the use of these educational facilities in the city of Detroit and found that the elimination of the facilities would reduce capacity by 24,000 pupils.

During recent years instruction by correspondence, particularly in the smaller high schools, has developed rapidly. Mitchell (257) discussed the plan of correspondence study which has been used for several years in the Benton Harbor, Michigan, high school. He stated that this plan eliminates small classes with their usual high per-pupil cost.

Pupil-teacher ratio—Steeper (271) presented a list of economies effected in North High School, Des Moines, Iowa. He stated that, while the staff was reduced from eighty to fifty employees, the pupil-teacher ratio mounted from twenty-three to thirty-five pupils for each teacher. He affirmed that over a period of fourteen years the present plan has resulted in more personal service to the individual student and in a more efficient school in other ways. Boyer (224) presented pertinent data relative to size of classes in the junior high schools of Philadelphia. He made suggestions regarding ways of meeting the situation when it became necessary to increase the pupil-teacher ratio as an economy measure. Cooper (229) cited such well-known studies as those of Stevenson, Davis, Trueblood, and Kauffman to substantiate the conclusion that large classes do as well pedagogically as small classes. In a few cases it appeared that the large classes do an even better quality of work than the small classes, and almost always the large classes do nearly as well as the small classes.

Management of the School Plant

Operation of the plant—Feinstein and West (233), Hart (239), and Jedlicka (245) have recently reported studies on the heating of school buildings. Feinstein and West found that other factors pertaining to economies in heating were more important than the selection of coal merely on the basis of potential heat content or ultimate chemical analysis. A more significant factor was found to be the units of water condensed per dollar expended for fuel. Hart described how to reduce heat losses by proper attention to window construction and use. He estimated that a saving of 15 to 30 percent in fuel cost could be effected in most buildings by proper attention to window construction and use. Jedlicka reported that in schools which use automatic stokers the percent of the budget for janitor's supplies and fuel is greater than for schools which do not use stokers. His tentative conclusion was that stokers are not an economy but he suggested that further research is needed on the problem.

Linn (251) described twelve factors to be considered in preventing waste and reducing the consumption of electricity. He pointed out that paying the same rates for power and heating as is paid for lighting is a potential source of waste. Linn (252) also contributed a study on ways of reducing water costs in schools. This study presented a table which showed how one city school district reduced its expenditures for water. The study listed ten rules for effecting economies in such expenditures.

Nesbitt (260) presented a study on economies in classroom ventilation. He concluded that in the light of presentday knowledge the conditions produced by systems of ventilation which provide large quantities of outside air at all times regardless of outside temperatures do not justify the cost of such systems either in installation or in operation.

Wylie (277), C. F. Miller (255), and Bosshart (222) have reported studies on school janitor service. Wylie stated that Los Angeles, by organizing a training school and a rating system for school janitors, in spite of a 10 percent reduction in wages and an increased janitorial load, was able to maintain the quality of service rendered at the level maintained before retrenchments were made. Miller pointed out many important economies that can be effected by a better standardization and supervision of janitorial service. Bosshart presented an outline of possible ways and means of reducing the operating costs of school buildings. His suggestions take into account such items as janitors' salaries, janitors' supplies and equipment, fuel, water, current, telephones, and office and classroom equipment.

Maintenance of the plant—Cook (228) stated that the most potent influence in securing efficient management of school maintenance programs is an annual survey to determine the relative urgency of the maintenance work to be done. He recommended an annual inspection of all buildings and equipment to ascertain which repairs should be made first. Frostic (237) suggested several factors to which attention should be given in the repair and upkeep of a school plant. He recommended that repairs be made when needed and that an annual inspection be given. More specifically he called attention to the need for frequent painting and similar repairs. Henzlik and others (240) gave many valuable suggestions for repairing school property. They stated that there is an economy in making repairs as soon as the need for them is estimated.

Insurance of the plant—Jedlicka (246) studied school property insurance through the use of a questionnaire to state departments of education and to county and city superintendents of schools. From 189 school systems which reported, he found that $2,634,860 had been paid in premiums over a ten-year period, but the amount of insurance received during the same period was only $674,031. He concluded, therefore, that almost two million dollars represented the price of insurance to these 189 school systems during the ten-year period. Holmes (243) found that an examination of the appraisals of 150 public buildings, most of which were schools, showed an average error of 30 percent in the insurance underwritings. He suggested seven sources of economies in school property insurance. Morton (259) suggested the following economies in school property insurance:

1. Determining more accurately the valuations of school property
2. Insuring property, particularly if fireproof, for less than full valuation

3. Securing lower insurance rates by eliminating fire risks
4. Adopting the co-insurance plan
5. Purchasing insurance for a longer term, for example, for three to five years.

Use of school buildings—Rose (266) reported that a staggered organization of classes in London, Ontario, made it possible to increase the capacity of the school plant by 100 percent. Allowing for the extra cost for the inauguration of the plan an estimated saving of $6,900 was effected the first year. She reported that so far as could be ascertained there was no loss in pedagogical efficiency from the plan.

Administration of Supplies and Equipment

Henzlik and others (240) devoted a section to the administration of supplies. The study reported that economies could be effected through such means as centralization of purchasing authority, cooperative purchasing, and standardization of quality and amount. It suggested rules and procedures for the proper storage, distribution, and use of supplies. Cooper (229) offered valuable suggestions for effecting economies in the purchase and use of supplies. Among these suggestions were competitive bidding in the purchasing of supplies, standardization of the quality and the amount of supplies, and proper control in the use of supplies. Thames (232) stressed the importance of sound business practice in the administration of supplies and equipment. He listed fourteen questions to be answered in effecting economies in expenditures for equipment and supplies.

During recent years a trend has been observed, especially among rural school districts, toward purchasing public supplies cooperatively. California now requires cooperative purchasing of school supplies on the part of the rural districts of every county. Not only has there been a tendency for school districts to join together in purchasing supplies, but school systems and municipal and county governments have occasionally purchased certain of their supplies cooperatively. For example, during recent years the city of Cincinnati, the school system of Cincinnati, and Hamilton County, in which the city of Cincinnati is located, have purchased many of their supplies cooperatively. Descriptions of this attempt have been given by Forbes (235) and by Lex (248). Both of these articles indicated that economies were effected for all three units of government.

Contrary to most studies which have been made of large quantity purchasing, Young (278) found that in North County, New Hampshire, only a small saving was effected by purchasing in large quantities. He found that economies came primarily through the standardization of quality. Frostic (236) stated the fallacy of purchasing school supplies entirely on the basis of price. He indicated that the cheapest supply often becomes the most expensive. Adequate specifications protect the consumer and enable the dealer to bid intelligently. O'Dell (263) pointed out the value of standardizing supplies within the school system. He affirmed that such standardization did not appear to handicap pupil achievement as many have claimed. He stated that in many regards standardization resulted in economies.

Transportation of Pupils

Up to the present time practically all of the research on pupil transportation has been conducted on the rural schools. During recent years, however, a slight tendency is noted to conduct research on the transportation of city pupils; for example, Hill (242) reported a comprehensive study of the transportation of city pupils. This study of 177 city school systems revealed that a large number have chosen to provide transportation of pupils rather than maintain small schools and departments which pupils could attend without being transported; in other words, these school systems have regarded transportation of pupils as an economy measure.

Most of the research on pupil transportation during the last two years has been concerned with the vehicles used. Blanding (221) reported an experiment in Lancaster County, South Carolina, on the best type of ownership of school buses. In that county, buses are now owned by the county, and private individuals are invited to bid upon a three-year contract to supply complete service according to definite specifications. Several advantages of public ownership of school buses are pointed out. Engum (225) came to the same conclusion. From a study of 245 motor buses in Minnesota he concluded that publicly owned buses are safer, more economical, and more comfortable than privately owned buses. Finch (234) also came to this conclusion. Statistics secured from a school district in Texas showed that a savings of $10,955.64 was effected in three years by changing from privately owned buses to publicly owned buses. This saving was made on a fleet of six buses. Gregory (238) found that in Oklahoma during the school year 1931-32 privately owned buses cost more than publicly owned buses. He stated that the average cost per pupil per day for privately owned buses was $.1199; for publicly owned buses, $.0717. In school districts which owned the bus body and leased the chassis, the average cost per pupil per day was $.1228. Still another study has pointed out that publicly owned buses are cheaper than privately owned buses. Carson (226) showed that districts in eight Ohio counties which owned their buses saved approximately 20 percent as compared with districts which did not own their buses.

For many years it has been recognized that one of the chief handicaps to research on school transportation has been the meager and inefficient transportation records which schools and school systems have kept. Records which would permit comparisons of the transportation costs of various school systems or of the cost of one school system over a period of years have been almost as scarce as the dodo. Richardson (265) was fortunate in having excellent records which showed transportation costs over a period of years. He concluded that the best way to secure economy in pupil transportation was to keep separate records on the operating costs of each bus.

Miscellaneous Financial Economies

Dudley (231) discussed ways and means of adjusting school budgets during the present financial stress. He found that the following two general methods of lowering school expenditures have been used during the present economic emergency: (a) certain phases of school work which have been recently introduced or which are no longer required have been eliminated; (b) the original program has been retained in toto and the necessary curtailments have been spread over the entire school program.

Pickell (264) discussed the principles of school budget making which are essential to economies. He stressed the importance of formulating the budget in great detail as well as of having desirable budgetary controls. He affirmed that when the budget has been approved it should be followed as faithfully as possible.

Linn (249) presented a checklist of more than 500 questions relative to economies in school administration. The questions were prepared so that an affirmative answer to them indicated a desirable and economical practice; if the answer to a question were given in the negative, investigation was to be made to ascertain whether an economy were possible.

Strayer (272) suggested how savings might be effected in making the budget, plant insurance, operation of the plant, utilization of plant and equipment, pupil-teacher ratios, consolidation of school districts, refinancing of the building program, care in selection of schoolboard members and well-trained administrators.

Sheffer (268) analyzed as follows the nature and purpose of educational activities which involved the collection and expenditure of money:

1. The management of school money
2. Purchase and utilization of materials
3. Purchase of protection for property
4. Management of indebtedness
5. Organization of schools and direction of personnel.

Hulton (244) prepared a checklist of seventy-one questions covering such functions as instruction, operation and maintenance of the school plant, school property insurance, and extra-classroom activities. The purpose of the list was to discover possible economies in the administration of city school systems. The suggestions were made especially for school systems in Pennsylvania.

The Department of Education of Massachusetts (254) made a survey of economies and retrenchments of the school districts of that state. Ten questions were asked and the answers summarized.

In New Jersey, the commissioner of education (261) called four regional conferences to consider economies in educational administration. Nine immediate possible economies were agreed upon. They related to the size of classes, reduction of number of failures, reduction of number of supervisors, economy in the purchase and use of supplies, less elaborate equipment, a moratorium on new plants, better utilization of classrooms, more efficient janitorial service, and the use of a lower grade of fuel.

Jordan (247) pointed out how saving the price of competence at the cost of incompetence results in an economic loss. In other words, he stated that to pay an incompetent employee only a few hundred dollars might beget more waste than to pay an artist employee several thousand.

CHAPTER IX

State and Federal Aid

THE preceding number of the *Review of Educational Research* dealing with this subject appeared in April, 1932 and considered briefly most of the significant earlier contributions in this field. Most of the important researches discussed in the previous survey were completed during the 1920-30 decade. In many respects the past full decade was the most significant in our educational history; and this was certainly the case with respect to the subject of state aid for schools.

The half-decade since 1930 has undoubtedly produced more of what one might call "activity" in this area; but our current survey seems to find it less important from the standpoint of research contributions. Financially, of course, the chief characteristic of the past five years has been the depression. During this time the general financial collapse, with its accompaniments in the form of shrunken incomes, bank failures, frozen assets, relief burdens, public retrenchments, impotent property taxation, and the like, has stimulated tremendous interest in the subject of state school support. The age-long heavy dependence of education upon local property taxation was never so questioned as during these years. The result has been a heightened activity in the area of state aid. States have seriously turned to the equalizing auspices of the parent state and to the equity and relief-giving power of the state's broader tax base.

This activity in the field of state aid has been characterized largely by movements looking towards the adoption of new state aid programs, by the actual passage of state aid laws, by changes in and extensions of state tax systems, and by an occasional radical or reactionary step—as one may choose to classify it—in the whole system of state support. Those interested in any of these developments should study the specific proposals and the legislation in the various states, such, for example, as Indiana, California, Wyoming, Maine, New Jersey, Kentucky, Ohio, Vermont, Tennessee, West Virginia, and North Carolina. Obviously, it does not lie within the province of this *Review* to discuss these developments in any detail, except where there were pertinent researches. Suffice it to say, that no student or layman interested in research in state aid can afford to neglect a close examination of the proposals, movements, and legal changes during recent years in the several states, and particularly in those mentioned above.

While, from the standpoint of research in state aid, the last half-decade, in comparison with the previous decade, seems definitely less significant, the activity of the period has shown unquestionably the effectiveness of the studies of the earlier years. The dominant research contribution of the

1920's was the equalization pattern. From a practical point of view nothing could have been more fortunate in school finance than that this pattern should have been designed and made available prior to 1929. Perish the thought that we should have been compelled to go through the present cycle with nothing better on which to build state aid than the helter-skelter schemes of the pre-20's! The equalization pattern has stuck. Even most of the argumentative discourses of the earlier days, such as "encouragement of effort" versus "equalization," have gradually dropped out of hearing.

It is quite clear, therefore, that the current problems of the research worker in this field have come to be (a) the refinement of the equalization pattern and technics relating thereto; (b) the evaluation of the already adopted systems of state aid; (c) the study of the taxation and funding aspects of state aid; and (d) the development of specific state programs. Possibly embraced in these areas, possibly outside them—perhaps for the administrator, the philosopher, or the social scientist, quite as much as the research man—are two closely allied problems. The first relates to the whole question of educational controls, and particularly those of the state. The second involves the problem of state aid versus complete state support, with its many implications and ramifications. These problems and much of their underlying significance are treated in the following chapter.

The National Survey of School Finance

Undoubtedly the most significant study of state support during the period here under consideration was made by Mort and his associates (297) in connection with the National Survey of School Finance, subsidized by the federal government. This comprehensive work has been reviewed so many times, commented upon so favorably, and given such wide distribution that it is unnecessary to attempt at this time any intensive review. No one could have been better qualified for the work than Mort, who, as a result of his earlier studies and work in over thirty states, was able, not only to visualize the problem in its entirety, but also to deal with it from the standpoint of a nation made up of forty-eight states.

The study is immensely practical. One finds here worked out in detail for each state the important measures of both minimum and defensible programs of state aid. The supplements by Joyal and Pearman (286) on statistics by states; by Sutton (309) on tuition and transportation; by Lawler (289) on the technical aspects of the pupil-teacher index; by Sutton (308) on salaries; and by Joyal (287) on legal provisions for apportionment of school funds, represent significant contributions. Lawler's consolidated calculator tables for elementary and high schools, based upon data from thirty-three states, are of inestimable value to anyone working with the problem in a given state and especially with limited research funds. If a state investigator were to have sufficient time and resources it would still seem to be desirable to work out specifically on local data the weightings for an individual state; but lacking time and resources—generally common conditions—the investigator may safely employ Lawler's calculator tables. Mort's and Lawler's original charts, representative of the Vermont data, for example, were found by the writer of this review, to follow the national norms with sufficient closeness to warrant fully the use of the calculator tables in that state.

This study has already proved its worth. It has been used by research workers, students, administrators, and laymen. Its very compactness and inclusiveness, coupled with its technical character, make it necessary for the uninitiated to read closely and often reread several times, a condition that could have been avoided had it been possible to afford a much longer treatment than the five hundred pages allowed. This work furnishes in itself an excellent review of state aid down to date.

Even surpassing, in importance to the research student, the study referred to above, is a companion work on research problems in school finance (312). While this volume deals with the whole field of school finance, it is of particular importance for those working upon state support. Chapter X of this number of the *Review* refers to specific sections. There is enough in this volume to stimulate and guide research in educational finance for a quarter century. In fact, it may prove to provide just that.

The effect of the unfortunately abbreviated National Survey was immediate, constructive, and timely. It stimulated and guided much of the activity during the past few years. Of similar nationwide influence has been the work of the Joint Commission on the Emergency in Education of the National Education Association and the Department of Superintendence. While not a research work, this Commission's *Report of National Conference on the Financing of Education* (285) should not be omitted as a work based upon and undoubtedly influencing research. The chapters dealing with state aid and taxation are of particular value in the development of new state finance programs.

The Research Division of the National Education Association (298) has undertaken a most valuable contribution in the field of state aid in editing a series of descriptive statements regarding the state aid systems in effect in each of the states. These are not research; but they should be read by every research worker in the field. Each state description was prepared by a contributor thoroughly familiar with the system. Twenty-five state summaries have appeared to date; others will be published soon.

Special State Studies

During the past three years there have been a number of significant state studies largely for the purpose of developing improved state support programs. Perhaps the most important from the standpoint of pattern, was the New Jersey study by Mort (296). Volume I dealt with school costs and economies and Volume II, with the reconstruction of the system of school support. Over $13,000,000 of possible retrenchments and economies were found after a careful analysis. The retrenchment possibilities, not necessarily advisabilities, were more prevalent in the wealthy communities, indicating, as might be expected, a negative relationship between the possibility of and the economic need of economies. Volume I deserves research attention for its tentative standards of transportation costs which represented a departure from both Burns' (281) and Johns' (284) technics for computing transportation costs.

Volume II of the New Jersey study (296) proposed a minimum state support foundation program of $57 and $98 per elementary- and high-school pupil respectively, and a local contribution of 4.75 mills. The proposed program was significant for a relatively high minimum guarantee of $13 and $22 per elementary- and high-school pupil respectively. Mort proposed an ultimately defensible program of $115 and $195. No cost of living corrections were to be applied until the ultimate program had been reached. The chief significance of the study from a research point of view lies in the commendable attempt to relate educational services to expenditures. It should be carefully studied from this angle, on which we need much more work than has heretofore been attempted.

Mort's study (294) of Maine followed the New Jersey study and bore resemblances to it, especially in the commendable approach to relationship between expenditures and educational value. The ultimately defensible program proposed in Maine was $45 and $76. As contrasted with the New Jersey proposal it illustrates the difference in possibilities among states and argues by implication for federal assistance in funding. The Maine study is one of the best jobs yet done. The public relations program which accompanied this undertaking, but which was not reported, should be studied by all state agencies.

Snavely, Hyde, and Biscoe (305) studied state aid in Virginia on somewhat more of a documentary than a technical basis and laid a good foundation for the scientific development of a state aid program. Adhering to the principle of equalization, it is worthy of note and commendable that the authors attempted, although not wholly successfully, to carry over this pattern into the non-educational fields of government. The authors seem to have run into a very natural pitfall, but one that needs minute exploration and seems to the reviewer to be regrettable, in that they appear to hold that whenever the state distributes a large amount of money to a local unit, it should exercise a correspondingly large control.

Sly and Shipman's study (304) in West Virginia reviewed the recent history of that state's effort to relieve the property tax by means of tax limitations. The authors indicated that the ultimate consequences of the tax limitation amendment were far from clear, that many difficulties needed to be corrected, and that the amendment could not be expected to produce permanently the relief which the taxpayer desired.

The reports of the Tennessee Educational Commission (311) and the Vermont Educational Commission (314) are interesting and stimulating to anyone who would compare and philosophize upon the two. The Tennessee undertaking followed the comprehensive route and represented a commendable cooperative effort; but it too often deviated from the equalization pattern which it apparently aimed to follow. Vermont's study was minute in comparison, especially in reference to state aid; yet no state survey ever adhered more closely to the equalization pattern. The Vermont study illustrated throughout the influence of the National Survey. It was conceived in retrenchment, but grew early into progress. Even now it has resulted in a progressive state aid law.

Several studies in the nature of general financial surveys have been made in recent years, such, for example, as the one by Larson (288) in Arizona. Larson indicated finance trends, dealt with the relationship of school to other governmental costs, and analyzed the reasons for increases in expenditures.

Administrative Aspects of the State Aid Problem

State Centralization in North Carolina, edited by Betters (280), deserves the consideration of students interested in the question of complete state support and its implications. This report was chiefly descriptive of the North Carolina experiment. At the time, this study could not have been scientifically critical, a procedure which is now possible and to be anticipated. On the face of things, if this chapter were dealing with movements rather than studies, the reviewer would have to abhor the particular program adopted by a great state.

Two studies of significance in relation to the very important question of administrative units were those of Little (292) and Strayer (307). Little approached the problem from the standpoint of potential economies and made a contribution in his formula for estimating cost reductions. Strayer studied particularly North Carolina, Maryland, and New York and found three different types of state influence. His study threw needed light on the question of local initiative and found that not the least among its conditioning agents was the larger unit of administration and taxation. This study represented an excellent review of the relationship of the state department to local units. Its central note was in the mooted area of controls, wherein more research must be undertaken. Strayer's study must be classified in the field of political science as well as in that of education. Another important study in the field of governmental units was the report of the Investigating Committee of Utah (313) which emphasized reorganization of local units and the strengthening of the central administrative board.

One of the most significant reports relating to fiscal administration was the symposium, edited by Leet and Paige (291). Through the pens of experienced and recognized authorities throughout the area of the social sciences, this report condemns constitutional and statutory tax limitations.

Beach (279) addressed himself to the safeguarding of school funds with particular reference to New York. He dealt with an important administrative aspect of state support in an able and constructive way, although his conclusion in favor of the depository system will bear further inquiry.

History, Theories, Evaluations, and Technics

The period here under review has not been prolific in studies in these areas of state aid. A few outstanding pieces of research, however, have appeared. Soper (306) traced the history of state aid in New York in a brief study which added materially to the research contributions of that state. There is a definite need of more work of this nature, done with the care and accuracy found in Soper's study. Wrightstone (315), basing his study on New York, threw needed light on the question of earmarking state aid funds. He concluded that equalization has been as influential upon educational expenditure as reward for effort, that the same results appear to have been secured with non-earmarked as with earmarked aid, and that local initiative is essential under any plan. McGuire (293), dealing with the question of equalization in the broad, contributed a well-developed discussion of the equalitarian philosophy and practice. Powell (302) contributed to the question of what educational return is bought by varying expenditures. His study is related closely to one of the features of Mort's Maine and New Jersey studies. Based on one-teacher schools in a single county, Powell's study was well under control, although its method limited its breadth, chiefly because of the reliance upon tests. Powell's work is judged by the reviewer to be of much importance. Achievement of pupils was found to correlate highly with expenditure.

Schmidt (303) previously dealt with a somewhat similar problem, but from the standpoint of the content of the educational program in relation to the financial plan. More particularly, however, Schmidt was concerned with what program a state should mandate. His study falls somewhere between that of Strayer and those of Powell and Mort. It has its greatest value in relation to local initiative. The student of this field should know Schmidt's work and his proposals for further research.

Lawler (290) produced the most technically valuable study of the period and, by the same token, perhaps the least known. He developed a technic for computing the amount of new aid required for state equalization programs. Mort will probably use this study more than anyone else; but as time goes on and we become more familiar with Lawler's work, it should prove of value to the administrator of state aid systems. The work may be taken to be accurate and refined. It is deserving of a more technical review than can be given here.

Pearman (301) studied the important question of earmarked versus non-earmarked revenue for state support with a result favorable to general revenue appropriation. Pearman's work deserves the attention of all states considering new systems of support and taxation. Systems of non-earmarked revenue were generally found to accompany executive budget systems.

Essex (283) studied the financing of school buildings with reference to bonding versus pay-as-you-go. Not strictly in the field of state aid, Essex' work has a distinct bearing upon any state's support of capital outlay. His emphasis upon the question of the worth of money in the individual community may well be followed up with further research.

The Governor's Committee on the Costs of Public Education in the State of New York (300) studied in 1933 the influence and need of a strong state aid system in that state. Studies of a factual nature were made under the direction of Strayer, as director of studies. This Committee recommended the state's adherence to the state aid program as developed prior to the depression.

Foreign Studies

It is gratifying to find Fletcher Harper Swift (310), the dean of students of educational finance, turning to the study of European policies in the financing of education. His studies of France, Czechoslovakia, and Austria are typically well done in the Swiftian manner. Not essentially studies in state aid, as we think of them, they are, nevertheless, just that in reality. At present in America, these studies are important for their exposition of the policy of rather complete national support and for the light which they throw upon the centralization of support and control as related to the future policies of our states. We need to know more of the things that Swift's studies describe—which is not to say that we should adopt the European policy. Perhaps more than in any other particular, the studies are revealing and instructive for American practice in relation to the determination of teachers' salaries.

Federal Aid

The period of the past two years has been one of great activity in relation to federal aid, but little of a research character has appeared. Much work, as yet unpublished in any comprehensive form, has been done, however, in this area by Mort, Dawson, Chism, and others. Mort (295) reported the development of a formula using density of population as a basic corrective factor. H. A. Dawson, in unpublished papers, has contributed greatly to a clarification of the need and desirable direction of federal aid. Chism (282) has taken the wind out of the sails of those who ask that the states "first put their own houses in order" by actually applying to states the model tax system of the National Tax Association (299) and then revealing the vast divergence of funding ability which still remains.

The federal relief agencies have contributed educational support through relief processes. The experience with relief and public works funds should form the source for valuable research. There is a distinct need for a comprehensive survey of the whole question of federal aid to education.

CHAPTER X

A Forecast of Future Research in Financing of Education

SIGNIFICANT progress has been made during the past few years on the problems bearing on the basic structure of school finance, as well as on the problems involved in the actual administration of schools. The depression has been fruitful in the development of interest in both of these areas. If we look towards the reconstruction of American education with any degree of optimism, we cannot but be considerably disturbed by lacks in knowledge in three highly important areas. The first division lays out significant areas for research which, if carried through, would seem to have potentialities for vast improvements in the efficient organization of our schools, and perhaps for vast economies. The second division indicates two of the problems having to do with the basic structure of school finance upon the answers to which may depend the health of American education for generations to come. The third division suggests researches which would have a bearing upon public attitude toward the support of education and upon policies of educational leadership in asking for support.

Efficient and Economical Operation of Schools

There are five important problems in the area of school financial management, considered broadly, which cry out for solution.

1. *Salary schedules*—Salary schedules have lapsed during the depression. If we come out of the depression, are we going to seek to restore only that which we had before or can we look forward to having some light on the fundamental issues involved in salary schedule development? What evidence do we have to enable us to say that the salary schedule should start out at a subsistence wage, a sub-subsistence wage, or a higher-than-subsistence wage? Considering the whole pattern of the salary which an individual might expect to obtain in education over a period of years, do we tend to pay the right amount as a beginning wage, are we paying more than necessary, or are we paying less than necessary, to draw in the superior individuals who should be drawn into teaching? How fast should the salary rise? What should be its ultimate peak? What should be the relationships between the beginning and later salaries to attract the right type of individuals? These are questions for which we have the sketchiest of answers. Certainly one of the needs which we face at the present time is evidence which will guide in salary schedule formulation. The opportunity before us in the reconstruction period to build on a solid foundation is large. What is the foundation? Suggestions for attacking this problem were

laid out by the National Survey of School Finance in the volume, *Research Problems in School Finance* (127: 78-79).

2. *Class size*—What about class size? Without attempting to criticize the importance of the work which has been done in this field, we are forced to admit that our ignorance in this field is profound. Most of the studies of class size have used as a criterion the average achievement of school classes. It should be apparent that one can affect tremendously the state of a significant number of pupils in a class without changing the average achievement significantly. If the students of this problem had consciously sought the criterion least sensitive to the effects of instruction on individual placement, they could not have done better than to choose the average of the distribution.

Perhaps the most significant studies in class size have been those that sought to take large groups of children for instruction in particular phases of school work. It has been pointed out by Stoddard and others that if a few very large classes can be operated in a school, the teacher-time saved would permit the operation of classes very small indeed in those aspects of the work of the school which demand close individual attention. Yet we have largely assumed that every subject and every phase of every subject should be taught to a class numbering somewhere between twenty and forty.

There are some indications from experience of teachers that there are certain critical points at which a class ceases to be a group of individuals and becomes a mass phenomenon. If such critical points exist, where are they? How do they vary from teacher to teacher? How can we select the teacher for whom the critical point is higher? What influence on the whole question of class size do the new media of instruction, motion pictures and radio, have?

Certainly the question of class size cannot be attacked and settled by a single individual. It is one of the problems which demands attack in a wide area by a great variety of individuals. Some suggestions for the attack on this highly important problem were made by the National Survey of School Finance (127: 74-77).

3. *Unit costs for categories of service*—What should a given type of service or material cost? This is a question upon which all of our masses of statistics throw but little light. Unit costs as we know them have been largely repudiated by practitioners in the field. The average cost of the program for medical service, for example, means nothing. Such an expenditure would be wasteful for a community that limits its medical attention to periodic, cursory inspections. Such an expenditure would be far from adequate for the community which attacks its medical problems on the level representative of the practice in many communities. Such unit costs, then, lull the backward communities into lethargic wastefulness; for the forward-looking communities they operate as trouble-makers. All of the promise which unit costs seem to have are in danger of going by the board.

Yet, the basic idea is sound. What is needed is the development of unit costs for categories of service. Such unit costs will not be repudiated by the progressive communities. They will serve as a basis for checking up the expenditures in the progressive communities as well as in the average communities. They will not whitewash wasteful expenditures for limited service in the backward communities. Suggestions for an attack on this problem also are given in the volume, *Research Problems in School Finance* (127: 46-53).

4. *Efficient local tax districts*—One of the most significant problems in the field of school finance is the problem of developing efficient local tax districts. While the many studies of the last decade have thrown some light on the problem, the serious difficulty in all cases save one has been in the attempt of an individual to solve the entire problem. The thinking of the staff of the National Survey of School Finance (127: 141-46) led to a line of attack which would, the writer believes, give us the answers to the vexing questions arising in this area.

Investigations laid out as a result of the deliberations of the staff and of the members of this conference required a study of each element that goes to make up an educational program in its relationship to efficiency and size of unit. Of the many independent investigations which have been made in the last decade, only one, that of Alonzo Briscoe on *The Size of the Local Unit for Administration and Supervision of Public Schools*, as yet unpublished, makes a drive along this direction. This dissertation, which was encouraged by the activities of the National Survey of School Finance, shows that the line of investigation laid out by the staff of that Survey is a promising one.

5. *Budgeting and auditing*—During the last decade considerable headway has been made in various states in the improvement of budgetary practices. The problem here would seem to be largely an extension and application of what is already known. There still remain states in which the idea of proper budgetary procedure is as foreign to most school authorities as cosmic rays. The trouble, however, would seem to be in the realm of application rather than in research.

In a closely related field the same cannot be said. The auditing of school accounts is still in its infancy. It ought to be a comparatively simple matter for someone skilled in this field to develop procedures which would make of the auditing something more than a mere accounting of bookkeeping. What is needed is an audit which will take into consideration proper expenditures for the type of service expected. At the same time, the audit should avoid control. Perhaps the key to the solution of this problem lies in the obtaining of proper unit cost data and in the training of individuals for school auditing who would have a sufficient understanding of the internal operation of schools to make the audit a significant and dependable safeguard. There has been enough experience with the problem of auditing by means of private agencies, state departments of education, and general state auditing departments to serve as an excellent background for significant research in this field.

Such research ought to go a long way in helping to establish practices which would still the honest doubts of those who question the ability of communities to handle their own funds. This would have a salutary effect in forestalling the drastic and dangerous movement towards centralized control of expenditures.

Local Taxing Power versus Centralization

1. *Local initiative*—There is probably no school problem of greater significance facing this generation than that of appraising the value of local taxing power. The traditional American practice of local taxation is now being overwhelmed by a rising tide of tax limitations, expenditure limitations, and other means of eliminating fiscal independence of schools. Here again, educational leaders are unable to speak with the authority which thoroughgoing research would make possible. Should educators oppose this movement and, by arousing the tremendous dormant public sentiment favorable to the safeguarding of education, turn back the tide? Or, should they welcome the movement as a means for eliminating practices which have no basis other than tradition?

A fundamental answer to one phase of this question can come only from an understanding of the functions of local initiative in American education. An appraisal of the claims for local initiative with respect to taxation seems to show that the case must rest upon the value of local initiative as a device for maintaining educational efficiency. To what degree does the adjustment of the educational system to new needs depend upon local initiative? To what degree have other devices been effective? Have those states which have hampered local initiative most through the hobbling of local taxing power found other means by which to keep at a minimum the lag of the educational programs? Have those countries which have built up their financial structures for education on complete central support been able to introduce devices which have kept this lag at a minimum? Considerable attention was given to this problem in the National Survey of School Finance (127: 147-52). With the aid of the Columbia University Council on Research in the Social Sciences, the writer of this chapter is now being enabled to pursue the problem somewhat farther. However, the research involved in the authoritative answering of these questions is one of tremendous scope.

2. *Dangerous by-products of necessary centralization*—The same issues must be attacked from another angle. We must appraise the dangers which arise from centralized control. We find ourselves swept along by tax reform movements towards more complete central support of schools. We have welcomed this because of the obvious necessity to obtain central support if an adequate minimum of educational opportunity is to be provided. We need to give constant attention to the dangers involved in this process.

Does the American political system have elements in it which will be brought to play when central governments have taken over larger responsibilities in support? Some of these dangers have been sensed. It is obvious from experience that when the decision as to the amount of aid to be granted a community is left to a central office with a central authority, all sorts of unforeseen controls creep in. Steps have been taken in the last decade to offset this difficulty by the setting up of objective measures making possible the passage of legislation establishing exact formulas for determining the amount of aid to which a district is entitled.

But there are other questions. If large central support is accompanied by tax limitations on local communities, there is a danger that we shall be in a situation where a reactionary legislature can blast the educational system of an entire state. If this is so, it can be avoided by the absolute insistence on the part of educators that tax limitations be avoided, that localities be given the opportunity to raise, from their own taxes, funds which a reactionary legislature might refuse to provide.

Some persons, appalled by the possibilities of difficulties of this sort, counsel against central support of education. Anyone who knows the facts about the ability of the communities to support education in any state, or the abilities of the states to support education, knows that this is counsel of defeat. What is needed, rather, is research into all the possibilities of evil from the necessary development of central support with the faith that forewarning can lead to forearming.

Productiveness of Education

1. *Returns for money spent*—More should be known concerning the educational returns on different expenditure levels. In connection with the Maine and New Jersey surveys (89, 92), some very useful material was obtained by inspecting the programs in selected low-, middle-, and high-expenditure communities. For this purpose a checklist of some two thousand items was utilized. The distinctive differences that were obtained by this process indicate a real promise in this area. What is needed is an improvement of the technics and an extension of their application.

2. *The economic value of education*—The determination of the economic values of education provides a fruitful field for investigation. Practically all economists have claimed high economic values for education. In spite of this, little has been done actually to appraise these values. The studies of Harold Clark have gone a considerable distance in appraising the values to the individual. Practically nothing, however, has been done in appraising the contributions of education to the general wealth. It would seem to be fairly obvious that if increased economic value comes to an individual in terms of salaries, or other payment for services, the paying agencies do not pass all of the advantage along to the employee. Some of this must be returned to capital and some must be distributed in the form of profits. A recent address by Chester I. Barnard, President of the New Jersey Bell Telephone Company, is particu-

larly suggestive in that it points out the dependence of highly organized industry, such as the Telephone Company, upon an educated public.[1] These leads should be followed up. Similar investigation should be made in other types of industries. William S. Nutter of the Goodall Worsted Company of Sanford, Maine, has recently called to the attention of the writer the significance to the textile industry of certain aspects of public education. If facts were collected in this area it might throw an entirely different light upon the ability of the American people to support public education. There is altogether too great a tendency to look upon education as a consumptive good, whereas the indications are fairly clear that it plays an exceedingly important part in our economic system as a productive enterprise.

3. *Taxes based on benefit received*—The problem just outlined suggests certain bearings on taxation. Perhaps the notion that education must be financed by taxes based on ability to pay is tied up with the broad assumption that education is purely a consumptive enterprise. It can doubtless be definitely shown that the consumption of certain types of goods is in no small way dependent on the education of the consumer. A way might be opened for certain types of benefit taxes which might go a long way in solving some of our taxation problems. At the present time, the economic productiveness of education is reflected in increased income to the individual, increased capital, and increased profits. It does not seem to be a particularly far-fetched suggestion to propose that part of this increased productiveness might flow directly back to the support of the basic enterprise—public education.

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REVIEW OF EDUCATIONAL RESEARCH

Official Publication of the American Educational Research Association, a department of the National Education Association.
The contents of the REVIEW are listed in the EDUCATION INDEX

Volume V **June, 1935** **Number 3**

Psychological Tests

(Literature reviewed from January, 1932, to January, 1935)

Prepared by the Committee on Psychological Tests: Gertrude Hildreth, Willard C. Olson, Herbert Toops, Goodwin Watson, and Harry J. Baker, *Chairman*; with the cooperation of G. Frederic Kuder.

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INTRODUCTION

In this number of the *Review of Educational Research* the topic of psychological tests covers tests of intelligence, aptitude, personality, and character. Reviews of these topics in the first cycle of the *Review* proved to be so voluminous that separate numbers were issued on tests of personality and character in June, 1932, and on tests of intelligence and aptitude in October, 1932. The present issue covers the three years 1932, 1933, and 1934; but even in this brief period the task of selecting important reports of research has been arduous, and literally thousands of them have necessarily been eliminated.

A review of psychological tests offers certain unique problems of selection which are difficult to treat satisfactorily. The discussions should be concerned primarily with the nature of the traits to be tested. But the nature of psychological traits are partly matters of rational deduction and philosophical formulation, and as such cannot be expressed as standard deviations or as coefficients of correlation. Although statistical devices are convenient vehicles for evaluating research, theories of trait constitution cannot be omitted or ignored in reports of research.

A second difficulty is that of presenting reports of research in the light of valid statistical formulas, without placing too much or too little emphasis upon statistical validity. In response to demands for greater emphasis upon the importance of statistical procedures, Dr. Toops has prepared a chapter of this issue dealing with that topic. His critical review of this field should be of interest to workers in fields of measurement other than psychological tests. Research confronts on one hand the danger of making deductions from data which are not statistically valid, and on the other that of becoming top-heavy and cumbersome with the necessary technics of validation.

Critical evaluations of psychological tests cannot be limited to the tests themselves, but must consider applications of results to specific situations, groups, and populations. Therefore it is practically impossible to consider psychological tests without reporting on such topics as sex differences, the efficiency of special instructional methods, the phenomena of mental senescence, or any topic susceptible to psychological measurement. In these discussions the fields of test applications border on those of instruction, of social differences, in fact on the entire range of educational and psychological processes. These marginal fields are being discussed in this *Review* primarily from the standpoint of test technic and secondarily from the practical, utilitarian application of results.

In the preparation of this *Review* special mention should be made of the contributions of Dr. Olson, who not only was assigned duties as subchairman for the tests of personality and character, but who also prepared a substantial number of bibliographies and abstracts for all members of the committee.

Harry J. Baker, *Chairman,*
Committee on Psychological Tests.

CHAPTER I

Intelligence and Its Measurement

SOURCES of general information about intelligence testing are given in Pintner's annual summaries (87) which cover theories, new tests and texts, and results of studies and investigations. A comprehensive bibliography has been prepared by Hildreth (45). General texts on intelligence and its measurement are offered by Boynton (14), by Garrett and Schneck (34), and a second edition in 1931 by Pintner (86).

This chapter will review the nature of intelligence in its general and special aspects; the clinical interpretation of functions; mental growth and changes; test standardization and variability; new tests; and suggested topics for further research.

Nature of Intelligence

General ability—For some years a debate has been in progress between Spearman and Thorndike as to the nature of general intelligence. Spearman (104) offered a hypothesis that there is a general factor "G" which permeates all mental activity and invariably produces a positive correlation between any two types of mental tests. A second "S" factor (actually a group of "S" or specific factors) exists which comes to light, depending upon the unique type of mental activity being tested. Thorndike proposed a series of traits more or less closely related to one another rather than a strong central "G" factor. Spearman (105) recently discussed this point by stating that an ability or trait which seems to be unitary may actually be a composite hidden in the various traits, and that the only safe procedure is not to assume what the tests measure but to study their intercorrelations.

Bruckner (18) disagreed with Thorndike (113) on the assumption that only a quantitative factor is the fundamental cause of differences in intelligence such as is measured on the CAVD tests. Bruckner held that qualitative differences in the original endowment of associative power are more important bases, and that Thorndike's tests involve the danger of splitting intelligence into partial segments without ever getting a grasp of the total mental constitution.

R. C. Tryon (118) examined ten important investigations with one hundred or more subjects by the method of tetrad differences and concluded that since the tetrads dispersed around zero, the Spearman two-factor theory was not as consistent as a multiple-factor theory of intelligence. Spearman (105) answered, claiming irrelevancy, incorrect interpretation, and disregard for the group-factor concept. In two studies Piéron (84, 85) deduced the existence of four types of intelligence: verbal, numerical, logical, and one of "common sense." He emphasized that the intercorrelations of these types are low which is also true between comprehension and invention. These latter two types, he believes, are the most common components of many intelligence tests. He contended that a whole series of mental tasks should be given which apply to all phases of learning rather than to what is ordinarily found in intelligence tests.

Thurstone (116) treated the theories of intelligence in somewhat the same manner as Piéron. He showed that Spearman's general factor and a second factor that is specific to each test or variable are actually only special cases within a multiple-factor theory. Eventually it will be possible to identify several mental abilities which reveal themselves as distinct and among them will probably be verbal ability, perceptual relations, and arithmetical ability. In the same discussion Thurstone reported the application of the multiple-factor theory to psychotic symptoms with the discovery of five clusters of symptoms, and also to vocational choices in which he found that there is a relatively small number of types of vocational interest groups.

These investigations with the improved statistical methods of analysis hopefully point to a better understanding of the nature of intelligence.

Special abilities—Investigations in the field of special abilities and disabilities have been comparatively meager, although certain new tests show some new attempts in this direction. When the analytical procedures proposed by Thurstone have better localized the special areas of intelligence, new tests will probably be developed to measure them. Many of the recent investigations on specific tests deal with tests of performance.

McElwee (63) analyzed the free association test included in the Stanford-Binet on 200 school children and found few association sequences, but in some cases children gave groups of objects in the same class. Hutt (48) offered a revision of the Kohs' Block Design Test, showing that of the three factors, success, speed, and moves, the third is of no value in increasing the diagnostic value or the validity of the test. Line and Ford (58) examined 705 children with the Knox Cube Test and found that the r with chronological age was low, with Binet M.A. was .58, and with school grade was .39. This test had low reliability and only four levels of difficulty. Edds (29) found very little in common between tests of verbal and nonverbal ability in measuring 53 college and 140 high-school students. Mental ages were developed for the separate tests or pages of the Detroit Group Intelligence Tests by Baker (7), and when taken with similar results for tests of mechanical aptitude afford a comprehensive profile of special abilities and disabilities. Wechsler (123) proposed a similar use of the subparts of the Army Alpha Test.

Performance and non-language tests—Several new tests in these fields will be mentioned later. Research projects on applications of such tests are few in number. Feinberg (31) reported correlations of Stanford-Binet and Pintner-Paterson tests on 807 children as being moderately positive with lower results for superior children and adults. Babcock (3, 5), using these same tests on adult foreigners, found them rating lower on the Stanford-Binet than on performance. Lincoln (57) reported high reliability on odd-even items and low Binet correlation for the Lincoln Hollow Square Form Board.

Four hundred children, grades 4 to 8, were tested by Armstrong (1) with Army Beta, short Army Performance, and Otis Group tests. Although he found an *r* of .633 between Beta and Otis, he recommended a re-standardization of Beta up to thirteen years of age. Army Performance has a more satisfactory standardization, but a lower correlation of .629 with Otis. He recommended Army Performance for clinical practice.

Senour (100) tested children from foreign families in East Chicago with Haggerty Delta 2 and Pintner Non-Language Mental Test and concluded that language handicap was rather serious in the Haggerty Test. Mowrer (75) reported on the performance of 83 children aged twenty-four to sixty-four months on 18 items of the Merrill-Palmer Scale. Bradbury (15) applied the Descoeudres Performance Test to nursery-school children, and reported on test administration and validation, with an *r* of .56 with Stanford-Binet.

Clinical Interpretations

In the clinical interpretations of intelligence, attempts have been made to analyze responses to tests and testing situations as well as to report the gross responses in terms of intelligence quotient or mental age. Various phases will be considered briefly here, since there tends to be an overlapping with test applications in Chapter II and with special talents and defects reported above.

Speed—Beck (9, 10) reported two studies on the factor of speed. He (10) reviewed thirty-four studies which showed a correlation range from –.32 to .90 between speed and simple discriminative reaction; –.03 to .53 with serial reaction; .14 to .32 with speed of reading, etc.—generally low correlations. In his other study he (9) concluded that speed, as measured in the usual test content, is not a measure of intelligence. C. Tryon and Jones (117) interpreted a low correlation between speed, as measured by screen exposure of simple narrative material, and altitude on the Thorndike CAVD tests as showing no marked community of function between speed and altitude or level of intelligence. Freeman (32) found a few, though important, number of cases among 117 university students whose scores on the Ohio State University Psychological Test were influenced by varying the time limits. Graf (38) found considerable shifting of relative rank orders of 100 policemen in the early stages of a series of mental tests. Constancy of rank tended to be reached only when about 80 percent of the total time had elapsed which would be necessary to complete the entire test. Sutherland (108) concluded that speed was a factor in intelligence only when the material was easy. Line and Kaplan (59) found that speed is not related to mental age, that it is subject to improvement with practice, and that the alertness of young bright pupils is probably stimulated by competition with older pupils in their classes.

Qualitative phases—The manner of test response is constantly in need of observation. Reymert and Hartman (93) found the correlation between early and later trials on the Knox Cube Test raised from .36 to .40 when the most variable first trial was eliminated from the computations. They found no constant relationship between procedure and intelligence and that the former can be judged only by observation. Tulchin (119) and Blumenfeld (12) emphasized the importance of such attendant factors as fatigue, embarrassment, stability, social and economic status, and language handicap. Medrow (67) reported that the methods and attitude with which subjects carried out form-board tests reflected personality, speed, comprehension, concentration, precision, thoroughness, and similar traits. Nass (76) devised a test of constructing designs by twining string around a board with about 100 wooden pegs. In making entire copies of designs as well as in completing a design when only a part was shown there was a surprising uniformity of kinds of errors. Figures to be copied could not be grasped as wholes but had to be analyzed into parts; and awareness of partial success was necessary for further completion of the figures.

Interpretation in psychopathic cases—The unique and unusual responses of psychopathic patients to mental test situations have furnished many valuable diagnostic clues. Schott (99) gave two or more administrations of the Stanford-Binet Test to neuro-psychiatric cases and found no relationship between variability and I.Q. level. Correlations between I.Q.'s on first and second trial was approximately .9 but the tests were used mainly as a barometer of the upward or downward trend of mental functioning. Babcock (4) stressed the need of studying psychopathic individuals as to the time of responses to familiar test material, as to their impressions of new test data, as to a measure of educational level, and as to variability between two test ratings which reflects a disturbed status of sensory functions.

Binder (11) studied psychopathic, neurotic, and normal cases on the Rorschach Test. He discovered that relatively much more importance must be attached to the central mood reactions in psychopathic personalities than in neurotic, and more in neurotic than in normal; and conversely, adaptivity to the peripheral or environmental stimulus plays a lesser role in the psychopathic than in the neurotic, and less in the neurotic than in the normal. Takamine (109) devised a complex performance test which required coordination in three different types of reactions simultaneously. The right hand turned down the crank to roll down a band of geometrical figures in an irregular order, so that these figures appear and disappear in a constant stream in which the subject must count all of a specified kind, and tap with a counter for the total number of all figures. On this test it was found that normal children decrease their errors with age, with a remarkable development in ability after the twelfth year. Girls were faster than boys but made four times as many errors. Motormen inclined to accidents made more errors than normal persons. Mental defectives finished in quick time but with many errors. In paralytic dementia, efficiency decreased to 70 percent, to 34 percent, and finally to complete inability. Dementia praecox patients remained at a relatively high level difficult to differentiate from neurasthenics. Traumatic neurosis patients had a low index of efficiency which became progressively worse. From these sample studies it is evident that much valuable clinical information can be gleaned from observing test reactions, particularly in performance tests.

Mental Growth

The problem of mental growth has always been complicated by the varying content of tests at the several age levels, by differing degrees of test difficulty and by inadequate knowledge of growth curves, particularly at the adult levels. For a more complete discussion of this topic the reader is referred to the report of Stoddard's committee (106). This section considers mental growth in general, the constancy of the I.Q. within various groups, and the characteristics of adult mentality.

General studies—Jordan (49) gave various forms of the National Intelligence Tests to 183 children for six semi-annual intervals. The I.Q.'s remained fairly constant and growth curves were practically parallel at all I.Q. levels. Takamine (110) examined the same group of 109 Japanese children for the six-year compulsory school course. Ninety-two percent of all individuals' abilities were predicted with reasonable accuracy from the initial tests. Wilcocks (129) tested 16,574 pupils in South Africa of European descent from twelve to sixteen years of age and found an almost perfectly normal distribution of ability with standard deviations increasing slightly with chronological age. Growth could be expressed in terms of a hyperbolic equation. Wheeler (128) examined the mental growth of dull Italian children for four consecutive years with the Dearborn Group Intelligence Tests. He found that at time of school entrance they were retarded nearly a year mentally. This increased to over two and one-half years at the age of eleven years. His data showed that dull children reach their mental maturity earlier than normal and superior children.

Constancy of the I.Q.—Nemzek (78) reviewed 247 titles and found test reliabilities running mostly between .75 and .95, so that charges of gross unreliability are unwarranted. P. Cattell (19) found a fictitious rise of four or five points in I.Q. due to familiarity with test material repeated within three or four months, but an insignificant gain when the interval between tests was six months or longer. R. R. Brown (17) reported twice as much variability in I.Q.'s when the interval between tests was from five to nine years than when it was less than two years, and that 25 cases in 100 change their I.Q. more than 15 points after a seven-year interval. Lincoln and Wadleigh (55) compared I.Q.'s of 150 children on three well-known group tests and found a shift of five points or less in 31.3 percent of the cases, and a shift of ten points or more occurred in 36.9 percent of the cases. This change is only approximately one point or two greater than for individual tests.

Preschool studies—There have been relatively more studies of test variability and mental growth changes at the preschool level than in any other age group. Wellman (124, 125, 126) made the most extensive studies in this field. In one of these studies she (126) found striking improvements in the I.Q.'s, especially by those below average. Gains in test scores are associated with preschool attendance. In her most recent report she (125) found that children who remained in the University system were higher in I.Q. by about 8 points at the age of eight and one-half years than those who had transferred to other schools. Non-preschool children made no change in I.Q. but matched preschool children made substantial gains.

> It would be better to think of intelligence test results as representing intellectual status at the moment and to proceed cautiously on the problem of precise prediction until more is known about variations under differing conditions. Certainly intelligence cannot be regarded as static; it should be regarded in terms of growth rather than as a fixed quantity. Nevertheless, there are probably definite constitutional limits within which growth may be altered (125: 80-81).

Hallowell (42) tested 438 children from three to forty-seven months of age and retested at ages from one to eight years. Test-retest variations of less than 5 points occurred in 48 percent to 55 percent of the cases, and 10-point variations included from 78 percent to 88 percent, mostly in the direction of improvement which he ascribed to change of environment and to development of language. Furfey and Muehlenbein (33) found that scores on the Linfert-Hierholzer scale administered in the second year of life did not predict Stanford-Binet scores four years later.

Additional experimental studies on other mental phenomena of preschool children were conducted by Shacter (101) who described a method for measuring sustained attention, Poyntz (89) on the efficacy of visual and auditory distractions, Rüssel (97) on form comprehension of two- to five-year-old children, K. A. Miles (70) on sustained visual fixation, Hurlock and Newmark (47) on memory span, and Grigsby (41) on the development of concepts of relationship as evidenced by their expressive ability.

The mentally gifted and superior—Nemzek (79, 80) reported two studies on the I.Q. constancy of the mentally gifted. In one study of 52 children on the Herring-Binet, test-retest ratings correlated .73 ± .04, with a range in change of I.Q. –19 to 22, as contrasted with .98 ± .01, and –3 to 8 respectively for average children. The average children were retested within twenty-four hours as against a one-year interval for the gifted. Lincoln (56) reexamined 92 children with I.Q.'s of 119 or over at intervals from five to eight years. He found that I.Q.'s tend to decrease and that girls' are likely to decrease more than boys'. P. Cattell (20) found I.Q. trends in 288 superior children just the opposite of Lincoln's results and of two Stanford University investigations.

The feebleminded—Woodall (130) reported an average trend of –0.45 points in I.Q. per year in 497 institutionalized feebleminded from six to sixteen years in chronological age; but above sixteen years of .99 points per year. Statistically significant upward trends occurred in 6.2 percent of the cases and downward trends in 8.2 percent. Girls were more variable than boys, morons more variable than imbeciles, and imbeciles more than idiots. A similar trend in I.Q. by age was discovered by Hoakley (46) in 550 cases. Fifty percent of all her cases were constant to within 5 points in I.Q. and extreme variable cases showed various causative factors.

Other groups—Gildea and Macoubrey (37) reported on 431 white patients of the Institute for Juvenile Research, Chicago, and found that 77, or 18 percent, had I.Q. changes of more than 10 points. They compared 73 of these with a similar number whose I.Q.'s had changed 5 points or less. Degree of cooperation, attitude toward examiner, and speed showed no relationship to variability, and degrees of reflectiveness and attention were slightly more favorable in the group whose I.Q. advanced. Improvements in physical condition, in parental attitudes, and in symptomatic behavior were definitely associated with I.Q. variability. Richey (94) made a comparison of 204 children whose naso-pharyngeal condition was satisfactory with 100 needing attention, and with 104 who had had their physical corrections. Removal of tonsils and adenoids had no measurable effect upon the I.Q. McAlpin (62) tested all the negro children in the 3A and 5A grades of two schools in Washington, D. C. The 3A children born in the District had an average I.Q. of 98.1; those born outside, 92.1. Similar figures of 95.1 and 89.7 were found for the 5A grade. The author concluded that the favorable environment stimulated mental capacities in the District.

Mental variability in adult levels and senescence—This topic is also discussed in Chapter II with respect to test applications. The chief studies have been made by W. R. Miles (68, 71, 72) who gave a series of psychological tests to persons from ten to ninety years of age. He found a rise in certain mental functions up to middle life and with considerable decline at senescence. Visual acuteness showed a slight decline up to age forty-nine, and 48 percent at age seventy to eighty-nine. In rotating speed of a small hand-drill mechanism, ages eighteen to twenty-nine showed the maximum scores; in hand promptness, ages fifty to sixty-nine; in foot promptness, ages eighteen to forty-nine; in immediate memory and judgment for position in spatial relations, ages thirty to forty-nine; in good judgment on an intelligence test, ages eighteen to twenty-nine. In general, mental efficiency at senescence declined about one-half of the maximum, which was reached at or near the age of fifty years. Sorenson (103) tested 641 university extension students ages sixteen to seventy with the Minnesota College Aptitude Test and Reading Examination and found that the curve for vocabulary ability increased with chronological age but paragraph meaning remained relatively constant. Mental use or disuse were chief causes of changes in curves of adult ability.

Test Standardization and Variability

A general discussion of statistical procedures is presented in Chapter IV. However, a report seems necessary here on specific studies dealing with mental-test standardization and reliability.

Test standardization—C. W. Brown, Bartelme, and Cox (16) presented a discussion of a scoring device for use with tests scaled according to the Thurstone absolute scaling technic. They used Gesell's Developmental Schedule and the California First Year Mental Scale for sampling material and presented advantages and disadvantages of the method. Several independent investigations have been made on the standardization of items on the Stanford-Binet. Wallin (122) and Phillips (83) showed the need for better standardization at its adult levels. Madden (66) found an increase rather than a decrease in the successes in year 9 over 8 for mentally slow children. Stoke (107) discovered that tests one and six of year 8 were more difficult than any other tests of 8 or 9. Test six in year 9 was found to be the easiest of that year, and Madden had found it to be second most difficult. Skalet (102) reported that tests involving interest in numbers, time, and geometrical form were relatively difficult, while tests of comprehension were easy. The author recommended the reevaluation of the I.Q. in the light of test difficulty. Louden (61) studied the two Stanford vocabulary lists and found that List 1 is decidedly easier than List 2 at the lower mental levels, approximately equal at the fourteen-year level, and more difficult above that point.

R. B. Cattell and Bristol (23) selected a new series of tests, inference stories, and puzzle boxes, and concluded that tests involving action and concrete material were most attractive to children but make the least demand upon intelligence; the best tests require either education of relationships or effectiveness of immediate memory. Radosuska-Strzemecka (91) standardized defining 15 words out of a list of 100 on subjects five to nineteen years of age. He proposed a seven-step scale of definitions ranging from pointing to the object to complete generalization. Perkins (81) studied Stanford-Binet test performance with respect to brightness. Tests IX-3, IX-1, XII-7, and XIV-4 are definitely "experience" tests, since more retarded children than superior children are able to pass them. Tests VIII-3, VIII-4, XII-8, X-2, X-3, XII-4, and XII-6 are passed more by superior than by retarded children.

Other tests—Vernon (121) reported a bibliography of eighty-four titles on test diagnosis for aptitudes, intelligence, and mental defects. He criticized the standardization of the Rorschach ink-blot test but was favorable to its qualitative significance. Lossagk (60), Levitov (54), Elderton (30), Bowers (13), and Cavalcanti (24) reported standardizations of visual imagery tests and spatial relationships. Lendzion (53) and Lahy (52) standardized tests for arranged numbers in serial order, with a positive correlation between short time of performance and good working methods. Wreschner (131) experimented with tests of judgment of characteristics common to several objects for children six or seven years of age. Attention was easily distracted, the field of vision small, abstract thinking rare, and perseveration strong.

Peterson and Peterson (82) reported on separate answer strips to allow for repeated use of blanks, and the Perfo-Scorer, the Thermo-Scorer, and the Chemo-Scorer with sensitive ink as devices to reduce the cost of test material.

Arthur (2) presented the process of standardization of her Point Performance Scale. Thomas (111) standardized the Phillips Group Scale on 5,900 children in Perth, West Australia, with the higher social group consistently better than the lower social group. Coutinho (27) added to the standardization of the Pernambucan revision of the Stanford-Binet for children three or four years of age. McElwee (64) presented norms for ages five to thirteen on the Ellis Memory Test for Objects.

Test comparability—Several investigations have attempted to compare results of various intelligence tests, and to explain the differences. The writer has found that the discrepancy between group intelligence and Stanford-Binet mental ages is due to the fact that the group tests measure "area" of intellect and the Binet is more a test of "altitude" according to Thorndike's description. Mentally retarded children earn higher and mentally accelerated children earn lower group than Binet mental ages on account of greater "area" scores for the retarded arising from greater chronological ages, and vice versa. This difference between tests may be approximated by deducting two months mental age for each year's difference between chronological age and group mental age. For example, a retarded pupil fifteen years of age testing nine years on the group test will tend to earn about eight years mental age on the Stanford-Binet; a mentally accelerated child six years of age, testing nine years on group tests, will tend to have a Binet mental age of nine years and six months. It will be noted that the identical group score for a mental age of nine years will be equivalent to Binet eight years in one instance and nine years six months in the other. P. Cattell (22) found both theoretically and empirically that there is a constant difference between the Binet I.Q. and Otis I.Q. at the extremes, especially the upper extreme. McElwee (65) found a correlation of .717 on 45 subnormal children between the Goodenough Intelligence Test and Stanford-Binet.

Group test equivalent scores—A manual for determining the equivalence of mental age obtained from group intelligence tests has been prepared by Runnels (96). Moore and Trafton (74) reported on equating scores for 235 Mount Holyoke freshmen on Terman Group A, Otis S-A, Army Alpha Form 8, and Miller Form A. A comparison was made by Miller (73) on results of six annual individual examinations of 160 subjects tested with five group examinations on the same day. The group results compare very favorably with results of the repeated individual examinations. Thomson (112) reported on two English investigations on standardization of group intelligence tests. Graf (39) explained discrepancies between German tests as due to differences in content. The Beltz test unduly stressed arithmetic; the Bobertag-Hylla test overemphasized logical thinking.

Durling (28) and Updegraff (120) arrived at different conclusions as to the reliability of Stanford-Binet on young children. Durling found them lower than Updegraff. Nemzek (77) found no consistent difference between Stanford and Herring I.Q.'s on 52 superior children. The question of a suitable C.A. divisor for Binet I.Q.'s was considered by Rappaport (92), who found a decreasing I.Q. for sixteen years, the smallest change for fifteen years, and no criteria satisfied in using fourteen years. The Heinis' personal constant as a suitable substitute for the I.Q. was urged by Hilden (44) and P. Cattell (21).

New Tests and Revisions

Group tests—The Cleveland Kindergarten Classification Test devised by Rockwell, Hawkins, and Connor (95) can be administered to groups of ten or twelve pupils at a time, and has ten subparts under the four heads of motor control, sense discrimination, English, and graphic expression. A few parts must be administered individually.

Pintner (88) has developed a group test in two forms (A and B) for grades 4 to 8 inclusive which requires about forty-four minutes to administer, testing vocabulary, logical selection, arithmetical reasoning, best answer, number sequence, classification, opposites, and analogies. Henmon and Nelson (43) presented Forms A and B, one set for elementary grades 3 to 8, the other for grades 7 to 12, with 90 items and a thirty-minute limit. Greene (40) devised the Michigan non-verbal series for ages five to twenty with four equivalent batteries for aiming, tapping, feature discrimination, and pencil maze. Norms are available on approximately 300 white persons with both sexes represented at each age level.

Wells (127) prepared a revised short form of Army Alpha which compares favorably with the original form, although only four of the eight subtests are used. Thurstone and Thurstone (115) continue to issue annual revisions of the American Council Psychological Examinations for high schools and colleges which require sixty minutes of work time, usually with four tests of sentence completion, arithmetical problems, geometrical analogies, and synonyms-antonyms. Cleeton (25) devised the Carnegie Mental Tests for high school and college. C. C. and W. R. Miles (68) standardized the Otis S-A Test as a fifteen-minute test. Sargent (98) reported an adaptation of the Otis Classification Test suitable for blind children.

Individual tests—The most ambitious project in this field is by Gesell and others (35) who have prepared an atlas of infant behavior, a 900-page work of two volumes with 3,200 action photographs. The first volume is a normative series on posture and locomotion; early perception and prehension; perceptual, prehensory, and adaptive behavior. Volume two is a naturalistic series of four boys and two girls of behavior patterns and episodes such as feeding, bathing, play, and sleep. Gesell, Thompson, and Amatruda (36) have presented an interpretation of the Atlas as to the genesis and growth of infant behavior.

Bayley (8) devised the California first-year mental scale with a test schedule of items from numerous sources. Norms are available on about 50 infants tested at an interval of about one year. Probst (90) standardized two forms of a general information test for children with 32 questions in 11 categories such as time, number, and simple mechanics. Kent (50, 51) reported a written and an oral test for clinic use. The latter has norms on 500 cases over the range from six to fourteen years with three overlapping point scales.

Baker and Leland (6) announced the forthcoming publication of the Detroit Tests of Learning Aptitude, a series of nineteen point scales each standardized on about fifty children at each suitable age level, with the median of the mental ages affording a general mental age. This test covers a wide range of verbal, spatial, number, motor-manipulative tests, auditory and visual spans, orientation and social adjustment which are symptomatic of special abilities and disabilities.

Cornell and Coxe (26) devised a Performance Ability Scale with seven tests including the Manikin-Profile Test, the Block-Designs Test, the Picture-Arrangement Test, the Digit-Symbol Test, the Memory-for-Designs Test, the Cube-Construction Test, and the Picture-Completion Test, which is designed to measure non-language ability. Descriptive material is given on the following groups: American-foreign, manual-verbal, verbal-markedly-handicapped-in-language, emotionally dull-volitional, social-non-social, extrovert-introvert. This scale offers a fine supplement to the usual verbal tests, and tests of this type are certain to have much wider use in clinical applications than they have had in the past.

Foreign tests—There has been considerable activity in the development of foreign intelligence tests which will be mentioned by author and without citation of specific reference, according to countries.

A 1932 Mental Survey Test was devised and used by the *Scottish* Council for Research in Education. Marshall standardized Spearman's "Measure of Intelligence" on children of Perth, *Australia.* Hales reported a standardization of Army Alpha for Sydney, *Australia. Chinese* tests were reported by Hsiao who describes an intelligence test of multi-adaptability chiefly of number content, and by Ou-Ni-Lin who describes a Chinese version of Binet-Simon. South American activity at *Pernambuco* was typified by Aranjo on Ballard's test, by Barerto on a test similar to Army Alpha and Dearborn Tests, Oliveira on an Alpha test, Campos on the Binet-Simon. *German* projects were represented by Norden on new revision of Bobertag's version of Binet-Simon, by Hetzer and Koller with a series of four tests for the second year of life, by Schlotte on a test based on 1,000 dull children at Leipzig, and by Schlag with a traditional group test for elementary-school children. In *France* and *Belgium* Simon reported a five-minute examination for retarded children similar to Binet-Simon, and Frickx standardized the Simon P-V test on Brussels elementary children. Foucault, Piéron, Lahy, Decroly and Segers report various new test standardizations for the mentally gifted, and an adaptation of the Ballard test.

Summary and Suggested Research

Research into the nature of intelligence has been facilitated by the development of many new tests of specific traits and by Thurstone's methods of statistical analysis. Non-verbal and performance tests have been devised for many foreign speaking groups, and for other special groups such as the psychopathic. The influence of preschool attendance upon intelligence is still a question of debate since there seems to be considerable gain in test scores. Measurements in adult levels show that growth continues later in life, and with a decline in senescence more definitely expressed than in any earlier investigations. Scores between different intelligence tests and between group and individual tests have been equated. A considerable number of new tests has been developed which attempt to be more diagnostic of special abilities and disabilities.

Further research is necessary in all of these fields and in the relationships of intelligence to specific educational progress, to vocational success, to personality deviations, and to many similar factors.

CHAPTER II

Applications of Intelligence Testing

INTELLIGENCE TESTING continues to serve the school, the court, the clinic, and the research laboratory in the study and adjustment of children and adults. Readiness for instruction is verified through the administration of intelligence tests in many schools. Waste resulting from school failure is transformed into school success when mental abilities are considered in school assignments. Predicting high-school success has become a paramount issue in large high schools enrolling a cross-section of a heterogeneous population. Scholarships are awarded on the basis of intellectual maturity shown by the candidate, maturity gauged in part through standardized tests. Scholastic aptitude tests are regularly included in college admission requirements.

Intelligence testing aids the psychologist, the mental hygienist, the clinician in determining the mental status of patients and subjects, in predicting mental growth, in formulating therapeutic measures, in the disposition of criminal and delinquent cases. In the courts there is an increasing tendency to suit the punitive measures to the culprit in proportion to his mental responsibility. Psychological service in all its aspects becomes more reliable and effective through the use of mental capacity measures.

Personnel selection in industry, in civil service, in the professions, is facilitated by mental development and intelligence tests. From policeman to college professor, the vocational guidance expert inquires to what extent general mental ability is required in a given occupation, and to what extent the applicant has the requisite ability. For uniform ranking of all candidates the test technic proves indispensable in vocational guidance service. Candidates for professional training in nursing, medicine, teaching, take mental aptitude tests which constitute a part of the prognostic test battery used for selection.

Intelligence testing has proved its value as a tool for the study of mental development from infancy to old age; for determining the interrelationships of intellectual qualities; for determining the distribution and central tendencies of intelligence in population groups, and the range of individual differences in age, sex, and racial groups; for establishing the relation between mental and physical qualities; and for studying the gifted and subnormal individuals in the general population.

The effect of improved physical condition on thinking capacity, of varying environmental factors on mental development, is tested in part through mental measurement of population groups. Social problems, immigration, sterilization, birth control, crime control are being studied through the mediation of scientific mental aptitude measurement technics.

A more critical attitude toward intelligence measurement, as the outcome of continued experimentation, has resulted in more authoritative research findings, more sensible and intelligent interpretation of data. Testing instruments of improved reliability and validity are now available for research purposes.

Conflicting results from similar research studies still persist due to variations in sampling, inadequate controls, lack of refinement in measuring instruments, inadequate or improper test standardization.

Applications of intelligence testing will be reported in this chapter under the following captions:

1. General Interpretations and Surveys
2. Intelligence Testing for Scholastic Purposes
3. Clinical Applications of Intelligence Testing
4. Vocational Guidance
5. Individual Differences in Intelligence and Mental Development
6. Relation of Intelligence to Other Traits

General Interpretations and Surveys

In a comprehensive textbook for college students, Boynton (148) discussed the nature of intelligence and mental measurement methods. Garrett and Schneck (200) prepared a book to be used as a text and laboratory manual for the training of students. Nihard (281) wrote a text for the initiation of teachers in the test method. Pressey and Pressey (301) revised an earlier edition of an introductory handbook in the use of tests. Webb and Shotwell (353) included material on intelligence and achievement testing from nursery school through the elementary grades in a textbook on measurement. Most of these publications contain extensive bibliographies. A summary of books and articles on intelligence testing has been prepared each year by Pintner (296). Reymert (305) reviewed mental testing conducted in colleges, schools, and clinics during 1932.

Thurstone (342) applied his multiple factor analysis theory to the study of mentality. He suggested that the vectors of mind are: verbal ability, perceptual relations, arithmetical ability. Wallis (351) made a critical examination of some concepts in the field of testing children. Colucci (166) evaluated the mental testing movement. Crawford (171) urged caution in the interpretation of test results; F. S. Freeman (198) commented on the improper use of psychological tests; and Zachry and Lloyd (367) suggested that the proper interpretation of intelligence test results required judgment, experience, and wide study of each individual case.

The widest scale survey of school children yet reported was made by the Scottish Council for Research in Education (322). Uniform mental examinations were given to 87,498 children between the ages of ten and a half and eleven and a half, practically the entire population of such children in Scotland. Fick (189) reported a mental survey of 25 percent of the school children in the Union of South Africa. Wood (365) reported the aptitude and achievement testing results in a large number of independent schools, and Woody (366) the testing program outcomes in a Michigan school system. Hildreth (216) prepared a bibliography covering the entire field of mental and educational testing, listing about 3,500 separate items. Kiesow (231) reported an effort in Italy to prepare a national collection of mental and physical tests, including apparatus, technics, tests, and questionnaires.

Intelligence Testing for Scholastic Purposes

Brown and Lind (156) concluded from intelligence and achievement tests of retarded and average school children that the relation of achievement to mental age depended not so much upon level of intelligence as upon the position of that level in the group instructed. Finzel (192) showed as the result of tests that the lack of relation between intelligence and school achievement was due to personality and developmental factors.

Heilman and McKee (213) studied the relation of achievement to intelligence and duration of school training and found that educational achievement is determined more by intelligence than length of school training. Bobertag (144) compared test scores of school children with their school marks. The tests had a higher coefficient of variability than the marks and the constancy of test results was better than that of the marks. The validity of test scores was .70. Witty and Brink (363) urged the adaptation of instruction to maturation levels. Foucault (194) emphasized the importance and described methods of measuring mental ability in school children.

Richards (307, 308) used a series of tests, including the Stanford and several auditory, visual, and form-board tests, in studying the abilities of first-grade children. He reported the relationship of psychological tests to school progress for 326 children. The average progress index was 90.

West (355) studied achievement resulting from ability grouping in the elementary school using over 4,000 pupils in grades three to seven. Results were given in terms of grade variability and needed adjustment in separate subjects. M. E. Broom (154) found a correlation of .73 to .80 between school achievement and mental tests in an elementary school. Engelhart (187) ascertained the contribution of mental ability to arithmetic problem solving and found that 25 percent of the variation in problem solving ability was due to variation in mental ability. Steiner (332) determined the annual variation in intelligence of first-grade children. Intelligence test scores proved to be a partial indication of success in later grades.

High school—Intelligence tests have been used for many purposes in the study of high-school problems. M. E. Broom and De Silva (152) concluded that achievement test batteries were reliable measures of the mental ability of junior high-school pupils, assuming that these pupils have had equal opportunities to learn. Turney and Fee (346) determined the relative value of five group mental tests applied to junior high-school pupils. Applying the criteria of discrimination and validity the tests were in ranked order: Otis Self-Administering, Terman Group Test, Haggerty Delta 2, National, McCall Multi-Mental Scale. The first three are of about equal value. Bowman (147) studied variability in arithmetic problem solving by high-school pupils in relation to intelligence. There was less variation in performance shown by pupils of higher intelligence. Partial correlation between intelligence test results and secondary-school achievement computed by Collier (164) proved the intelligence tests to be the best predictive measure of several used, but a combination of three predictive measures proved to be most reliable. King (232) compared the value of nineteen mental and fourteen interest factors in high-school prediction and found the mental test the more reliable. Maller (258) determined that scholastic success in high school can be predicted from age at entrance with as much reliability from intelligence measured by standard tests. The intelligence quotient is slightly superior to raw score for high-school sectioning, according to the results of Symonds (335).

A survey by Mayer (268) of secondary-school pupils in several types of German schools proved the pupils enrolled in gymnasia to be most gifted. The pupils in the *Bürgerschule* did well; those of the *Realschule* poorly. Dowd (182) determined that high-school pupils are an intellectually selected group, judging from group intelligence test results obtained in the sixth grade. For predicting success in algebra, Ayers (140) found prognostic algebra tests, a reasoning test, and teachers estimates to be superior to the Terman Group Intelligence Test. Torgerson and Aamodt (344), however, found an algebraic ability test, an algebra prognosis test, and an intelligence test to be about equally valid for predicting algebraic success.

College—College prediction and achievement have been the subject of considerable research. Asher (138) found the partial correlation technic of little value in analyzing educational problems when applied to intelligence and English test results. Whether or not knowledge of intelligence test scores influences an instructor's scholastic grades was investigated by Constance (168), who found a positive influence in one instructor's case. Davis (176) surveyed the intelligence and achievement of 1,400 college students in Kentucky and sought to determine their relationship. The scholarship average of each college approximates a general average regardless of intelligence average. M. A. Gordon (204) found no significant relationship between the student's intelligence and the amount of school work he was carrying. Henry (214) investigated the relationship of aptitude test data to fall quarter grades in ninety-nine cases. Keys and Reed (230) found in comparing summer and regular session students on the American Council Test that the summer group had a larger proportion of superior students, an equal number of inferior students, superiority in the teacher and school administrator group, and superiority in the high-school compared with the elementary-school teachers. The predictive value of the groupings of the Thorndike Intelligence Examination was studied by Lefever (243) who found the best predictive measure for success in the freshman year to be the total Thorndike score.

Masters and Upshall (266) found that normal-school students gained in scores on repeated Thorndike examinations. Results obtained by Messenger (271) indicated that poor students can be eliminated from teachers colleges before entrance by the application of a battery of intelligence and achievement tests. In order of predictive value for success in college mathematics, the most effective technics proved to be the American Council tests, English, chemistry, mathematics tests, according to the report of Perry (292). Roucek (313), experimented with intelligence and knowledge tests applied to students in the Charles University in Prague. Fifty-eight percent of American colleges included in a survey reported a gain in average student intelligence test score during the years 1930-33, according to Thompson (339). Wagner (349) found test scores on Regents examinations more valid than intelligence test scores in predicting the scholastic success of college students. Waits (350) reported a high differential predictive value for the American Council Psychological Examination. Watson (352) used four factors in predicting success of Kentucky University freshmen, namely, high-school scholarship, intelligence test scores, English achievement, and mathematical test achievement scores. In administering mental tests to 1,800 students at the University of London, H. D. J. White (357) found that the ranking in departments from highest to lowest was as follows: arts, science, medicine, librarianship and laws (tied), engineering, journalism, architecture and fine arts. No significant difference was found between the scores of men and women. Students with low scores but good scholarship concentrate better and work longer hours. Those with high scores and poor scholarship records have wider interests, more anxieties, are less healthy. Whitmer (360) proved the value of giving freshmen probationers' assistance and guidance through a comparative study of groups who had and had not received such assistance. Williamson (361) discovered that the intelligence tests were most successful in the prediction of scholastic success of high aptitude freshmen, whereas, high-school percentile rank was more successful in predicting good scholarship of low aptitude freshmen. Wolcott (364) found a correlation of .809 between initial and subsequent Thorndike Intelligence Test scores three and a half years apart.

Professional—The use of intelligence test scores in scholastic prediction for student nurses is reported by several research workers. Bregman (149) obtained intelligence test scores for 10,000 student nurses. They ranked as a group below college freshmen level, but above the high-school norms. More highly selected groups were found in institutions of higher rank. Frankford (195), applying a group test to student nurses entering the training school, found a correlation approximating .80 between these test results and subsequent performance. After two years the number satisfactory in performance who scored originally above the 50th percentile was much larger than those who scored below. Habbe (209) found that the psychological test scores of those student nurses resigning were below those succeeding.

W. B. Jones and Iffert (226) concluded from results of intelligence tests given to 777 prospective student nurses that measures of knowledge and ability can be used to advantage in selection. A test of aptitude for nursing added little to the psychological test. Potts (300) found that the scores of student nurses retained beyond the probationary period were substantially higher than scores of those not retained.

Rhinehart (306) attempted to determine the value of a battery of tests for predicting success in both academic work and practical accomplishment. The American Council Psychological Examination proved of greater value in predicting grades than the Stanford-Binet. A group of student nurses beyond the probationary period proved to be more intelligent than a college group of the same age in a study made by Rosenstein (312).

Triplett (345) found a group of commercial college students to be only slightly below college norms for the American Council Psychological Examination. Ullman (347) found little predictive value in a variety of teacher ability ratings, among them intelligence test scores. R. V. Jordan (228) summarized several studies of teacher and student-teacher intelligence. The data indicated that student teachers as a group rank at the median in terms of college entrance test norms.

Clinical Applications of Intelligence Testing

Delinquents, prisoners, and criminals—Armstrong (135) investigated the parental stock of juvenile delinquents arraigned in a children's court. Twenty-eight percent were of Italian stock, 20 percent Russian, and 12 percent colored. These percents vary from the proportion of these groups in the general population. The delinquent children averaged 77 I.Q. Beane (142) surveyed 300 delinquent girls and analyzed the results with respect to intelligence level, social, economic, and school training factors. Intelligence quotients for incarcerated delinquent boys as reported by Charles (161) have close agreement when results from several tests are compared. Cochran and Steinbach (163) found that the delinquent children do not yield the highest amounts of recidivism. The performance of feebleminded and delinquent subjects was determined by Knight (237) through the use of performance and verbal intelligence tests. The performance quotients were higher for all groups than the intelligence quotients.

Lane (241) summarized data for delinquents in the St. Charles School. On the Otis Test the median I.Q. was 88.2. On the Binet in 145 cases it was 80.7. McClure (256) found the mean intelligence quotient of 600 juvenile delinquents aged from seven to seventeen to be 79. The average for the boys was slightly higher than for the girls. Rogers and Austin (311) obtained I.Q.'s for over 3,000 juvenile delinquents. A normal distribution curve was found with a mean at 82.2. Retests after several years showed correlations of .63 to .82. Ruggles (314) analyzed the factors contributing to juvenile crime in a group of boys sixteen to twenty-two years of age sent to a prison farm. The group of boys studied proved to be much below the average in intelligence and mechanical ability. The factor of intelligence deficit is given undue importance among other causative factors of juvenile delinquency in the opinion of Steinbach (331) as the result of investigations in the juvenile courts of Norfolk. R. K. White and Fenton (359) discovered, among other facts in comparing groups of bright and dull delinquents, that forgery was the only offense associated with higher intelligence.

The median intelligence of unmarried mothers was found to be 76 in a study reported by McClure and Goldberg (255) confirming results of an earlier study by them. Growdon (207) reported a mental survey of 2,185 adult female delinquents in the state of Ohio and concluded that for white and negro races and two classes of delinquency, the reformatory prisoners fall below the mental ratings of their respective races in the general population. Mennens (269) reported successful differentiation of prisoners through administering the Healy Completion test. Recidivists and first offenders of average and defective intelligence have equal chances of successful subsequent adjustment, according to Shimberg and Israelite (327) who studied groups of average and defective offenders.

Defectives—Aldrich and Doll (132) compared the development of idiot boys nineteen to thirty-eight months old chronologically with normal infant boys of the same age range on a series of three development scales. The idiots were superior on the performance tests of the Stutsman series, but inferior on the language tests of the Kuhlmann-Binet Series. The same authors (133) studied problem solving in idiots through reaction to tools. Individual differences were found among the experimental group. Arthur (137) reported the same mental classification for the majority of over six hundred feebleminded inmates of a state school after retesting, with intervals between tests ranging from one to five years. Doll (181) at the request of New Jersey surveyed the status of the feebleminded in the state. He reported incidence and educational provisions.

Durling (184) reviewed the literature on economic status in relation to I.Q. and studied the employment records of high-grade mental defectives. She concluded that the defective can do work of a routine nature successfully, but only under constant supervision. Fischer (193) used problems in abstraction, definition of concepts, grasping relations, and criticism to diagnose mild degrees of feeblemindedness in adults. Gordon (205) used the Merrill-Palmer Pre-school Scale successfully with low-grade mental defectives. The normal preschool child has a better command of language than the mental defective of the same age. H. E. Jones (225) differentiated the abilities as shown by tests for adult and juvenile defectives. On the Binet sub-tests groups equivalent in mental age or opportunity showed marked differences.

Murphy (278) analyzed data for nearly seven thousand cases who received mental examinations at the Psychological Clinic of the University of Pennsylvania. Twenty-nine percent were diagnosed as feebleminded. In the past five years feebleminded cases incidence has declined due to a change in the attitude of the public toward the clinic. An experiment with a group test for distinguishing defectives from normals among groups of older school children was reported by Otte (286). Parker (289) investigated the educational proficiency of subnormal children in reading, arithmetic, and spelling as compared with standards for normal children. Portenier (298) found from studying test records in eight cities that the average I.Q. of the high-school population has declined slightly during the past decade and the percent of low mentality pupils who graduate has increased. The low mentality high-school pupils are a selected group with reference to economic and personality factors.

Porteus (299) revised the original maze test series and proved its usefulness in studying the behavior of defectives and delinquents as well as for general examining. Shimberg and Reichenberg (328) questioned the social adjustment of those feebleminded who never reach an institution. They studied 189 cases. Those who adjusted successfully had slightly better heredity, were from better homes, had more favorable personality traits, were those for whom recommendations made were carried out, and were better supervised. From a study of the mental status of children of mothers who were inmates in an institution for the feebleminded, Vanuxem (348) found that half of the children tested rated higher than the mothers, and a considerable proportion were equal in status when compared with the mother.

The gifted—Decroly (179) emphasized as the result of research the need for measuring the non-verbal as well as the verbal abilities of gifted children. Burkersrode (157) devised a new series of tests for the selection of talented children in their fourth year of school. The tests were used in conjunction with an observation record. Gifted children, discovered through a battery of intelligence, achievement, and aptitude tests employed in the Iowa high-school survey, were further studied through questionnaires sent to parents. The group were found to come from superior homes, graduate early, and attend college.

A report by Manrique (263) described the use of intelligence tests in selecting gifted children for scholarship grants in Spain. Otto (287) attempted to select by means of tests the more gifted children who should go on to high school. From results of the tests used he drew deductions concerning the nature of intelligence. Moore (277) made a cumulative four-year study of students graduated from high school before sixteen years of age. The students were superior at graduation in intelligence and achievement and maintained their superiority throughout college years. Scheidemann (319) surveyed an opportunity room for gifted children. He found the group to be superior in achievement and intelligence, and less well adjusted emotionally than a comparable group of normal children. Sylvester (334) described in detail five cases of gifted children demonstrated at the University of Pennsylvania. The Harvard growth study, according to Cattell (160) indicated Binet I.Q. increase with age for gifted children. The earlier Stanford study had shown more decrease. The different results are attributable to selection and difference in ages of the group tested. Hollingworth (219) found that problems of emotional immaturity in children who test above 130 I.Q. observed in high school tend later to disappear.

Other clinical applications—Bronner (150) urged the use of psychological tests in clinical practice in studying unevennesses in abilities. Camp (158) advocated the interpretation of tests in clinical practice in the light of the patient's developmental school and medical history and heredity, and Crane (169) found qualitative examination data as significant as total quantitative test results. The same author (170) showed through a case history the value of thorough testing for diagnostic purposes. Jastak (221) compared responses of normal school children to a variety of test items with responses of children with personality difficulties or behavior disorders. The vocabulary items were least affected by personality disorders. More complex performance test items were more sensitive to mental instability effects. Wires (362) found the reactions of patients in a psychopathic clinic afforded an excellent basis for diagnosis.

Vocational Guidance

Brown (155), discussing the use of intelligence tests in vocational guidance, pointed out difficulties due to overlapping in ability of occupational groups. Pond (297) prepared intelligence score distributions for 9,000 factory men divided into 44 occupational groups. Great overlapping from group to group was found, but averages and range in both test score and schooling correlate better than .74 with an occupational ranking based on estimates of intelligence required for success. Reifenrath (304) found no positive correlation between general and technical or commercial intelligence in several thousand subjects in various vocational groups. Christiaens (162) discovered that intelligence measures using only verbal material were inadequate for vocational guidance. He has found the Decroly Box Test helpful in vocational prognosis. Fryer and Sparling (199) evaluated intelligence testing for vocational success prediction purposes. Farmer (188) found a low correlation between an entrance test and a final proficiency test in skilled trades, but the correlations were raised with the addition of intelligence test ratings. Thorndike and others (340) in a follow-up study of 2,000 children examined at fourteen years of age found low correlations between early test data and subsequent vocational success.

Individual Differences in Intelligence and Mental Development

Anderson and Scheidemann (134) made detailed reports of three sets of triplets, including developmental history, mental and personality test results. Finch (191) obtained for 1,023 pairs of siblings a correlation of .49. Outhit (288) comparing the intelligence ratings of siblings with each other and parents with their children found correlations of .42 to .72 between first-second and first-third sibling. Between mid-parent and mid-child, correlations of .77 to .80 were found, and between single parent and single child, .40 to .68. H. D. J. White (357) compared the intelligence ratings of twenty-six pairs of twins and obtained correlations of .82 using the Binet test, and .92 using the Kuhlmann.

Sex differences have been determined by several investigators. Book (145) found among university students that men excelled on maze and block counting tests, and the women on number checking and pattern recognition. Employing the Goodenough Drawing Test method De Oliveira (180) observed that up to the age of nine the girls are superior, after this the boys achieve the higher mean score. Conrad, H. E. Jones, and Hsiao (167) analyzed army test results for sex differences in groups of children and adults in a rural community and found the females superior to the males. The superiority varied with sub-tests.

F. N. Freeman (196), studying individual differences in mental growth, found that slower growth children do not necessarily reach the end of their mental growth period earlier than do the faster growth children.

F. S. Freeman (197) summarized findings on the extent of individual differences, influence of environment, race and nationality, differences due to sex, factors of age, physical development, and personality.

Marked correspondence in occupational level of parents and their children characterized the data obtained from the cross section of a typical school population by Hildreth (217). A. M. Jordan (227) studied the influence of parental occupation on test scores for over 1,200 school children in grades one to seven. Substantial differences in mean test-scores for various occupations were found. In the genius group appear only children of professional workers. The median score increases with improvement in economic level.

Davidson (175) conducted an experiment in which bright, average, and dull children all at the four-year mental level were given practice in reading. The bright group proved to be noticeably superior, the dull noticeably inferior in reacting to the experimental material. Driscoll (183) compared the reliability of Merrill-Palmer and Kuhlmann materials in predicting future development of young children. Prognosis was more accurate from the preschool composite rating than from the I.Q. alone. A statistical summary made by Louden (248) proved the superiority of the bright children over the dull children in Stanford-Binet vocabulary response.

In a large adult population Grace (206) found no relation between age and mental ability. H. E. Jones and Conrad (223) in studying growth and decline of intelligence in a group ranging in age from ten to sixty, found a decline by age fifty-five amounting to recession to the fourteen-year level. Miles (273) summarized the results of the Stanford Later Maturity Study. Declines were universal in all traits tested with advance in age, but decline is less rapid in some traits than in others. The same author (272) constructed ability-at-age curves for ages ten to eighty-nine for sensory acuity and mental traits, and found that maximum ability in a wide range of functions occurs between eighteen and forty-nine. Decline is not precipitous but progressive. Shacter (325) investigated the relation between sustained attention in school children and I.Q. Correlations were not of any appreciable size.

Harter (210) investigated individual differences in 247 men and women subjects with digit-letter substitution tests. Individual differences due to practice persisted throughout the learning. Perl (291), using a series of mental, vocabulary, and arithmetic tests with fourth-grade school children, found increases in individual differences in three out of four tests and decreases in one test. Increases occurred in complex processes; decreases occurred in the simpler processes. Shultz (329) gave five symbol learning tests to college and technical school students a week apart, and found that the individuals varied quantitatively and qualitatively in performance according to the normal distribution curve.

Relation of Intelligence to Other Traits

Intelligence and physical status—M. E. Broom (153) found a very low positive correlation to exist between cranial capacity and scores on intelligence tests among college men and women. Low positive correlations were found to exist between physical and mental age and physical and mental quotient in institutionalized feebleminded boys, in a study made by Davenport and Minogue (174). Dawson and Conn (177) attempted to determine whether any relationship existed between disease condition and Binet test results in hospitalized children. Some illnesses are followed by more mental deterioration than others. Guilmartin (208) summarized the use of psychological tests with deaf children. Subjects of superior intelligence as rated by standard tests showed greater physical development on the average than those in a subnormal group reported by Lucena and Barreto (252).

Maller (260) obtained data for 310 health areas in New York City with reference to vital statistics, juvenile delinquency, school progress and intelligence. He found a marked degree of intercorrelation in all factors studied. Marked national differences were found in each measure. Merry and Merry (270) employed with good success the finger test as a supplementary test of intelligence for blind children.

Nilson (282) studied the intelligence test results of physically disabled children among an unselected school population. Results for the disabled children compared very favorably with those for the physically normal children. Patrick and Rowles (290) found negligible relationships between physiological measures, vital indexes, intelligence, personality rating, age, and point-hour ratio among fifty-two university women. A narrow age range may have affected the relationships found. Richey (309) paired children with and without diseased tonsil or adenoid condition and found only small, unreliable changes due to continued diseased condition or its removal. No relationship was discovered to exist between measures of intelligence and physical condition by Schell (320) in a comparative study of siblings, one of whom had a diseased condition, the other not. Wellman (354) summarized studies reporting the relationship between physical maturation and mental maturity. No relationship was found to exist between some measures of physiological maturity and mental development.

Intelligence and environmental conditions—Armstrong (136) compared groups of urban and rural children with the Otis Intermediate Test and two performance tests. The rural group was superior in verbal and abstract intelligence to the foreign-parentage urban group. Children in either group, if of American parentage, of equivalent occupational class, and of equal educational opportunity, were similar in the abilities measured. Although it is impossible to predict intelligence or scholarship from socio-economic status, according to the conclusions of Cuff (172) an association was shown in college groups measured with the American Council Psychological Examination between the test results and rating of socio-economic status. Figuerido (190) discovered considerable influence of the social environment on test results in administering the Dounaievsky test to university level students.

F. N. Freeman (196) concluded from studies of duplicate twins reared apart compared with those reared together that the former differed from each other in ability about twice as much as the latter. He found no evidence that slower children reach their mental growth earlier than faster children. Newman (280) reported a series of pairs of identical twins reared apart from infancy. The contrast in environment of the various pairs differed as did also the scores in mental and educational tests. Hicks and Ralph (215) practiced a group of nursery age children in tracing the Porteus maze with both preferred and non-preferred hand. The practice did not result in significantly greater skill.

H. E. Jones, Conrad, and Blanchard (222) found, in comparing test results of rural and urban children, that the rural environment was a handicap. They concluded that a rural child moving to the city would increase his intelligence test scores merely as a result of changed environmental conditions. H. E. Jones (224) summarized studies of birth order and intelligence. He concluded that results were conflicting and that therefore the findings were negative. Such studies are liable to error because of the many factors that must be controlled. Kawin and Hoefer (229) measured with Merrill-Palmer Tests two- and three-year-old children who attended nursery school and those who did not. No differences were found between children who had and had not attended nursery school. Kirihara (233) analyzed the results of intelligence tests for children coming from different social levels. He concluded that the relatively poor showing of children of the laboring classes was due both to inheritance and milieu. Liberman and Elperine (244) concluded from an analysis of test results that many tests give an undue advantage to urban subjects. From comparing initial and retest I.Q.'s of orphan-asylum children Lithauer and Klineberg (245) concluded that improvement in environment apparently has a favorable influence on the I.Q. Luria (254) studied the verbal reactions of children from different environments and concluded that these reactions can be evaluated only in terms of environmental opportunity. Maller and Zubin (259) studied the effect of rivalry motivation in test achievement. Although no increase in score was found, more items were attempted, errors increased, and greater variability in score resulted. In a study reported by Pintner (293), children from non-English speaking homes made better scores on primary non-language tests than on primary tests requiring comprehension of verbal directions.

Pintner and Forlano (294) distributed over 17,000 I.Q.'s according to birth-month and found the lowest I.Q. level for each social group to fall in the months from January to March. Senour (324) concluded from a study of intelligence test results for children from foreign homes that verbal tests rate the children lower than non-verbal tests. He recommended the use of the non-verbal in preference to the verbal test.

Sherman and Key (326) measured the intelligence of isolated mountain children and concluded that the children develop according to the demands of their environment. Intelligence was highest in communities of higher social development. Wheeler (356) concluded from the results of testing Tennessee mountain children that environmental factors materially affected the results.

Syrkin (336) found superior test scores for children of Soviet officials as compared with children of workers. Even when vocabulary differences are eliminated the superiority of one group over the other remains.

Schwesinger (321) summarized all recent material on genetic and environmental factors as they affect the development of intelligence. Technics for the measurement of intelligence and personality are described.

Snedden (330), repeating the same and different forms of the same test, found greater practice effect in repeating the same form of the test. An entirely different test resulted in still less practice effect.

Intelligence and other traits—Attenborough and Farber (139) investigated the "G" factor among mechanical ability, intelligence, and manual dexterity tests administered to school children. Correct judgment of intelligence from penmanship occurs only by chance, according to B. H. Broom and Basinger (151) who compared centile placement of adults in penmanship and intelligence. Carroll (159) obtained positive correlations between intelligence and literary judgment as the result of administering a prose appreciation test and intelligence tests to high-school students.

Dawson (178) concluded that the less intelligent population groups are increasing at a rate greater than the more intelligent and might in time greatly outnumber them.

Durrell (185) observed that the results of group tests varied with the amount of reading required and concluded that group tests containing a large amount of reading material should not be used for the computation of intelligence or accomplishment quotients. Goodenough (203) reported that a fairly close relationship existed between drawing progress and general intellectual development. Hartge (211) determined the intelligence of high-school girls by three methods: intelligence tests, teachers ratings, graphology. There was 56 percent agreement among all three methods. Hildreth (217) concluded as the result of administering verbal and non-verbal tests to young bright children that these subjects were equally competent in both types of tests.

Jaggers (220) compared the intelligence of 47 problem children and 48 well-adjusted children above the fourth grade. On three tests the median I.Q. of the well-adjusted groups was 112; for the problem children, 96.

Koester (238) investigated the interrelations of intellectual aptitudes, and talents for music, drawing, and technical skills. He concluded that in passing from the superior intellectual groups to the less intelligent groups the percent of subjects possessing a very definite special talent decreases, and those judged mediocre increase. Loomis and Moran (247) discovered that the use of "a," "an," "and," and "the," in written composition correlated more highly with mental age than any other part of speech. Children studied by Lowry (251) who were given three months' intensive training in reading increased their I.Q.'s on a second intelligence test following the training period, compared with a test given before the training period, to the extent of 11.76 points. Matheson (267) compared the intelligence ratings of preschool children with response to problem-solving situations of the Kohler type and found positive correlations with mental and chronological age. Monnin (274) computed correlations between intelligence and arithmetic from tests given to school children. Moore (276) concluded that the distinction between "linguistic and non-linguistic" is not exact. Although the functions are distinct, they may be measured in a single test, either linguistic or non-linguistic. Morison (275) reported that the speech habit, echolalia, was never observed in any but the mentally defective. Rust (316) studied resistance to tests in young children and found negative correlation between resistance and intelligence quotient, positive relationship between resistance score and difficulty of the test. Taylor (337) found a high positive correlation between visual apprehension and mental and chronological age in child subjects who were shown a number of toys. Tinker (343) observed that speed of response is associated with mental and scholastic test responses when speed and ability were measured on the same kind of material.

Racial characteristics and intelligence—The intelligence and mental development of negro subjects has been reported in several publications. A selected bibliography on the physical and mental abilities of the American negro has been prepared (323).

Beckham (143) summarized the results of Stanford-Binet tests given to 1,100 school children and found variations between test results and school grade, age, occupation of parents, family size. There was little correspondence between vocational aspirations and ability. Bousfield (146) measured the ability and achievement of negro school children in Chicago. The subjects rated normal on the non-language test, below norms on other tests.

Klineberg (235, 236) concluded that cultural and environmental factors have an important bearing on intelligence test responses. Colored children were found by Long (246) to be on the average 4.76 points below the average white child in intelligence quotient, but this difference he attributed to environmental factors.

Nissen, Machover, and Kinder (283) used performance tests in evaluating the mentality of native African negro children five to fourteen years of age in the area supplied by the American slave trade. The tested subjects were inferior to the norms for the tests. Results were more favorable in the tests less related to civilized content. Pintner (295) investigated intelligence differences between negroes and whites. The intelligence of negroes appeared to be lower than that of the whites. Price (302) reviewed the literature on the problem of negro-white differences in intelligence and concluded that there has been no comprehensive measurement of negro intelligence, no valid comparison with whites.

Stowell (333) in a comparison of white and negro institutionalized feebleminded children found the negroes to be younger and mentally superior to the whites.

Thurmond (341) compared the intelligence and achievement of twelve-year-old negro children in a rural district of Georgia. The children proved to be retarded on the Arthur Performance, Stanford, and Illinois Tests to the extent of two or more years. Using the Arthur scores as a criterion, they were retarded one and a half years in spelling, three years in handwriting. Using Stanford M.A. as a criterion, the retardation is less serious.

Mexican children tested by Manuel and Hughes (264) proved to be equal to other children, grade for grade, in intelligence and drawing. Manuel (265) concluded that the Mexican child ranks below the average school child in Texas both in intelligence and school record. The inferior test ranking of Spanish-speaking children is not as Sanchez (317) concluded, peculiar to Spanish-speaking children generally. The same author (318) found gains in all abilities tested in a group of Spanish-speaking children in New Mexico, and urged consideration of testing conditions in making racial comparisons.

Collmann (165) compared the Otis Test scores of children of Victoria, Australia, with the norms and found no significant difference between these children and those on whom the tests were standardized. Oliver (284) made adaptations of test materials for measuring the mentality of Africans. Because of limited educational opportunities in the groups tested, little use was made of school knowledge materials. The same author (285) compared the abilities of English, French, and native subjects in their respective colonies.

Several investigators reported studies of Jewish mentality. Maller (261) reported data concerning the intelligence of young Jews. Roback (310) reviewed the literature on the measurement of Jewish mentality and attempted to explain Jewish superiority. Another summary on the same topic was made by Rumyaneck (315).

In measuring groups of part-Hawaiians with the Binet, Porteus Maze, and Healy Picture Completion Tests, Louttit (250) found children of Hawaiian-white-Chinese mixtures superior to other groups. Fourteen years appeared to be the upper limit of mental development in these groups. Eells (186) found the average I.Q. on the Stanford-Binet tests for Eskimo, Aleut, and Indian children to be respectively 73.67, 80.27, and 78.88, and on the Goodenough Drawing Scale 89.56, 93.29, and 91.55. I.Q. appeared to increase with greater admixture of white blood. Garth (201), who employed a carefully controlled technic in studying the intelligence and achievement of mixed blood Indian children, concluded that mixed-blood bears only a slight relationship to intelligence. Telford (338) compared Goodenough test performance of Indian, white, and negro children. The average I.Q. of the Indians was 88; of the whites, 100; and the negroes, 77-79. Indians proved superior to whites on the mare and foal test. No significant correlation was found between performance and amount of Indian blood. Luh and Wu (253) found Chinese children in Peiping to be equivalent to American children in performance test achievement.

Barke (141) used non-language and verbal mental tests in comparing children aged ten to fourteen in three bilingual schools in a Welsh-speaking mining district with children in monoglot schools in an English-speaking district. Children in the bilingual schools appeared to be slightly superior.

Reichard (303) found differences in Slav and Jewish immigrants of both subjects associated with schooling, sex, and age. No racial difference was observed. As the result of non-language tests administered to immigrants, Kolb (239) ranked racial groups in order of superiority as follows: Norwegian, English, Swedish, German, Irish, and Italian. The differences ranged in terms of test age from 1.5 to 6.5 years depending upon the test.

Haven (212) obtained a higher intelligence quotient, but a lower achievement quotient for native-born as compared with foreign-born children when tested with the Otis Classification Tests (form fourth to eighth grade). No significant racial differences were found by Louttit (249), in comparing students of white, Japanese, Chinese, and Hawaiian ancestry in Hawaii on tests of immediate recall. Daniel (173) criticized existing studies of racial differences and proposed a list of sixteen criteria which must be met to make racial difference studies valid. Lambeth and Lanier (240) studied speed of reaction in groups of negro and white twelve-year-old boys and concluded that the more complex the test the higher the relative score of the whites. Nassri (279) applied the Pintner-Paterson scale to French school children and concluded that national differences in comparing the subjects studied with American subjects can be demonstrated.

CHAPTER III

Measures of Aptitude

To the accompaniment of much healthy self-criticism the development of aptitude tests has gone on apace during the past three years. The literature for the period contains over two hundred titles on aptitude tests for many lines of endeavor—advertising designers, engineering apprentices, book revisers, dentists, dressmakers, executives, modistes, policemen, salesmen, shoemakers, surveyors, teachers, weavers, and others. The largest number is reported in the German journals, followed by those of the United States and England. Also represented are France, Italy, Russia, Spain, Australia, Argentina, and Japan.

The line between aptitude and achievement tests is always a thinly drawn one. Sections of many of the tests mentioned above are out-and-out trade tests. A general characteristic is the absence of published validity coefficients. In an aptitude test this lack is far more serious than the general lack of published reliability coefficients, shown by Woody (478) to be characteristic of most published tests. Reliability can be had cheaply, usually, by simply lengthening a test. Validity responds but little to lengthening.

Some articles report impressive validities based upon less than twenty cases. Rare indeed is the study which tells of an aptitude test having been validated upon some group other than the experimental group employed to determine the selection, weighting, or scaling of tests and items. Apparently most aptitude tests die aborning.

Common Misconceptions

A number of common fallacies to be guarded against have been pointed out by Crawford (385), Kitson (418), Kingsbury (416), Hoppock (408), and others. These are as follows:

1. One should not take for granted that a test with a certain published reliability and validity will have the same reliability and validity when administered to all other groups.

2. One should not assume that the regression of all traits upon success is linear. For example, groups of exceedingly conventional or exceedingly conservative artists may both succeed excellently, while the intervening group may find its product unsaleable. An occupational trait profile constructed from a population of all artists or made up only of individuals from the two extremes is meaningless.

3. It does not follow that the resemblance of an individual's profile to the occupational trait profile of the average man in the occupation or even of the 75th percentile man, or better, in the occupation, is an indication of success in the occupation unless the traits making up the profile are those which, in combination, are highly valid in predicting differential success in that occupation. This is a caution against the hasty adoption of the ape-the-successful-man type of psychology.

4. There is no indication of validity, as assumed by some, in the fact that a graph of the first quartile points and of the third quartile points parallels a graph of the median points on a series of tests arranged in a sequential order as in profiles.

5. Consistent status on two or more highly interrelated (alternate forms of) tests or functions (labelled "mechanical ability," "social intelligence," etc.) is no evidence in itself of validity even if plotted in a profile. Alternate forms of tests or tests highly intercorrelated will yield essentially identical normated scores even though the validity of the tests in common is approximately zero.

6. The drafting of a profile does not in itself imply validity. All tests yielding distributions, *ipso facto,* have norms; therefore they may be included in profiles. But of what avail to be tenth decile rather than first in a test of zero validity!

7. It is a fallacy that "anyone can be trained to do anything equally well."

8. It is a fallacy that "there is a certain niche in the economic system for which each person is designed by nature, if he can only find it."

The Inadequacy of First Degree Regression Equations

Johnson (410) pointed out a fundamental weakness of aptitude testing as generally practiced today, namely, that the measures now generally used are strictly additive, no provision being made for the possibility that the absence of any one trait or characteristic may mean failure in a given field of endeavor regardless of the presence of many other favorable characteristics. Kelley (415) and Toops (462) described the use of higher degree equations, involving multiplicative scores for dealing, among other things, with this situation (see Chapter IV).

Another method for meeting the situation more adequately is through prediction from "patterns" of characteristics. Large scale statewide testing programs, for example, are bound to secure fairly large groups of people who are "alike," and studies based on such like-patterned groups should yield pertinent data as to the potence of different patterns in predicting various criteria of success. Projects now under way in which such studies are eventuating or may be expected to eventuate are the statewide intelligence testing and achievement testing programs of Alabama, Colorado, Georgia, Indiana, Iowa, Kentucky, Minnesota, Mississippi, North Carolina, Ohio, Oklahoma, Wisconsin, and Wyoming; and the extensive occupational testing and employment stabilization projects of Minneapolis (455), Rochester (409), and Cincinnati. The study of patterns will be greatly facilitated by a recently discovered method of identifying and coding profiles (468). Graphic treatment of patterns has been described recently by Trabue (469, 470), Dvorak (394), and Segel (449, 450).

Need of a Standard Group for Reporting Validity and Reliability

Validity and reliability coefficients obtained from different groups simply are not comparable. The field of vital statistics was in a similar predicament until the "standard million" concept was brought into use. Death rates in Arizona and Massachusetts are not comparable until the effects of different age and sex distributions are ironed out. Reports on the reliabilities and validities of tests will continue to be relatively unintelligible to the prospective user until a similar standardization is successful.

Need for Interpreting Scores in Relation to the Individual's Stage of Development

The influence of time in the development of aptitude has largely been ignored. All tests yield cross-section views of ability. Yet seldom are a number of successive testings assembled into an individual "growth curve," a special case of the profile in which a single test function with successive retests is graphed instead of tests of additional functions. The state of scientific advancement at the present is characterized best perhaps by the statement that the resources of a Croesus probably could not at the present moment locate the growth curves of height of twenty individuals measured annually from birth to the age of twenty-one. Courtis (382) stated that an excellent I.Q. can be determined for an individual by a consideration of the rate at which he erupts his teeth. He (381) also pointed out that a single test is uninterpretable unless the conditions of motivation are known and are uniform for the group. The work of this research worker is deserving of more attention from scientists, educators, and test-builders than it has had. The inauguration of cumulative records alone does not necessarily insure the accumulation of even the basic data for such investigations. The units employed must be equivalent over the range of growth; the intervals between measurements preferably should be arithmetical and uniform for all; the reliability of the measuring instruments and of the measuring methods must be high; and the conditions of motivation of the subjects must be controlled and be expressed in definite (verifiable) categories. Considerable effort has been made recently to measure periodically, interview, and follow up individuals over a period of years. Noteworthy researches of this type are Terman's studies of genius (377); the Pennsylvania study of the Carnegie Foundation (379); the annual tests of children by Dearborn (401) and the Brush Foundation (461); and the follow-up of 2,000 children over ten years by Thorndike (460).

What Should Be the Criteria of Aptitude Tests?

Just what criterion an aptitude test should predict has never been settled to the satisfaction of discriminating investigators. "Success" is a handy word with which a fight may be started in any camp. Is success a matter of remuneration and job level or of one's suitability for the job as judged by self and employer? Thorndike (459, 460) has chosen one set of measures; the investigators of the London (395) and Birmingham (368) experiments have chosen another. Macrae (423) has pertinently observed: "The truth is that the estimation of actual success is almost as difficult as the estimation of potential success."

Admittedly, grades are a sorry measure of the success with which an individual meets the college situation. Yet these have been used universally as criteria for lack of anything better. Grades are a hodge-podge of many characteristics of the individual, the instructor, the course or courses taken, and the situation.

That average grades for different individuals are comparable is a dubious assumption in the light of the variation in the difficulty of courses (402, 476). As Kitson (419) has pointed out, identical averages may represent vastly different performances. A given average for one person may represent fairly uniform achievement in all subjects taken; for another, the same average may represent high marks in some courses and low marks in others.

Tyler (471, 472) and his associates have been making rapid progress in the matter of measuring educational achievement by defining objectives in terms of specific observable behavior and developing efficient methods for their measurement. The question of the proper combination, if any, of these measures still remains a problem.

Attack on the problem of making ratings more reliable has been made successfully by the American Council on Education, as reported by Bradshaw (375), by Stevens and Wonderlie (454), and Richardson and Kuder (445). The trend appears toward specifics, using statements and phrases such as would naturally come from the tongue of the raters. The last-named study applied the Thurstone scaling technic of equal-appearing intervals in the development of a list of statements which are marked as being true or not true of the individual rated.

Evaluations of Test Programs

Evaluations of the results of four aptitude testing programs over a period of years have appeared. In one of these, reported by Thorndike, no vocational counseling took place. In the other three, vocational counseling was given to the subjects on the basis of tests, school records, and interviews.

Thorndike and his associates (460), in an extensive follow-up study of children, undertook to find out how well school records up to the age of fourteen and test scores at the age of fourteen would predict future educational and industrial careers. They concluded from their data that, in general, school grades reached, scholarship marks, intelligence test scores, or any combination of these, predict later success in school fairly well, but that little can be predicted, by means of the tests employed, as to vocational success to be achieved by the age of twenty-two. The reservation is made that such prediction may be better for a later age when the superior individuals are out of school and well along in their careers. Of note is the observation that there is much indirect evidence that employers do not fit wages to services very accurately in the case of these young workers, and that there is direct evidence that they pay substantial premiums for mere size in the case of clerical workers. The conclusion is reached that "even if the correlations with services rendered should be as low as those with wages received (they probably will be much higher), test scores will be much better than prejudices and superstitions." The findings of this inquiry have raised a storm of heated criticisms on a number of counts (436, 423), chiefly on the point that the experiment cannot be taken as a test of the possibilities of vocational guidance since no attempt at guidance was included in the research program.

A second follow-up study of children who had been given vocational advice at the London Institute of Industrial Psychology was reported by Macrae (424). The earlier and more extensive follow-up by the London Institute was reported in 1931 by Earle and others (395). The later study discovered 79 percent of the guidance predictions to be "correct" for the group of nearly 200 subjects. Any prediction was classified as "correct" if a guidee who succeeded had followed the Institute's advice and if a guidee who failed had rejected it.

A similar follow-up of individuals who had been given vocational guidance by the Australian Institute of Industrial Psychology was reported by Mirk (427). It was found that 86.6 percent of the subjects had acted in accordance with the advice given. Of these, 92.3 percent considered themselves wholly satisfied, 5.1 percent partially satisfied, and 2.6 percent wholly dissatisfied with their work. Of the subjects who had not acted in accordance with the advice, 8.3 percent reported they were satisfied, 25 percent partially satisfied, and 66.6 percent dissatisfied with their work.

A control group of children who received advice based on interviews only was used by Allen and Smith (368) and Allen (369) to check the results obtained from an experimental group of children who were given counseling with the aid of psychological tests upon leaving school. The findings indicate more satisfactory results from the use of tests in guidance than from guidance without the use of tests (control group). Thorndike has suggested that the favorable results obtained are due to the fact that employers and children were "influenced" in their ratings of suitability by the recommendations and whatever discussion accompanied them. To this Macrae (423) retorted that there was an equal opportunity for similar discussions with members of the control group.

Statewide Cooperative Testing Programs

Statewide testing programs have developed in a number of states as reported by Segel (451) and Proffitt (444). Such programs are directed toward measuring the achievements and capacities of students in order that they may be helped to the most effective development and participation in today's complex society, and are, in a very real sense, directed toward evaluating individual aptitudes.

In addition to directing attention to the importance of individual differences and having measures of them for consideration in the choice of courses and vocations, these programs are intended, among other things, to carry new objectives of education to the schools; to put scholarship on a par with athletics as to attractiveness; and to locate promising students for purposes of college recruiting. Minnesota and Ohio are seeing in the intelligence scores gathered a means of transmuting high-school marks to a common basis by the system hereinafter described, and for obtaining for prognostic purposes "character quality" inherent in high-school marks. A student of low intelligence must be a consistently hard worker in order to make good grades over a four-year period, while an intelligent student with consistently low grades may probably be classed as lacking in academic interest and drive.

A minimal guidance program as outlined for the state of Ohio has been described by Toops (463, 466). Particularly noteworthy in the Ohio program is the use of a guidance manual, *Opportunities in Ohio Colleges*, which places in the hands of the high-school student information, secured by a uniform questionnaire outline, about the specific colleges of the state. Included is a device by which the student rates the several colleges which he is considering on a number of specifics, the relative importance of which was decided by a vote of presidents of Ohio colleges.

While statewide programs have as yet given little attention to the objective evaluation of personality characteristics, such a development is needed. The Ohio College Association is at present considering a social participation inquiry partially to meet the need. It is proposed to make a survey of students in a large number of Ohio colleges in order to determine what strengths, deficiencies, aims, and purposes are associated with participation or non-participation in extracurriculum activities and to determine the pattern of traits that identify those individuals who need (a) personality development through extracurriculum activities and (b) curbing of extracurriculum activities in the interest of a well-rounded personality program.

Noteworthy points in reports of statewide testing programs are as follows:

In Wisconsin, the issue of freeing the public schools from the pattern of prescribed entrance units has been raised since the tests are so much the better pronosticators of college success than the patterns of subjects studied (405, 407).

It has been pointed out in Ohio that the colleges of the state could be recruited twice over from students above the 40th percentile in the distribution of intelligence scores of Ohio College Association freshmen, and thus the need for thousands of scholarships is squarely raised (465).

The Pennsylvania study points out that forgetting is an important phenomenon of college learning, seniors often knowing less than freshmen in a given topic, and that the products of colleges are no more uniform than the products of the secondary schools, thus implying the need for transmuting the marks of the colleges as well as of the high schools (379).

In Minnesota, a simple transmutation of averaged high-school marks has been shown to be of as much value as intelligence tests for predicting college success, thus suggesting this as a function which should be performed annually in all states (411).

All in all, the statewide testing movement bids fair to lead to a new kind of educational statesmanship in which the total talents and attainments of state populations shall be as carefully considered by a state's guidance director as are those of the citizenry of nations in time of war. When such shall have been done, it is inevitable that consideration be given to the contention of Clark (380) to the effect that the present economic dilemma, and its increasing complexity whenever the growth of population shall have stopped, can be solved only by a national occupational planning board. This board would have as one of its chief jobs the creation of thousands of new occupations—mainly service occupations—and which will subsidize preparation for and entry thereupon.

Scholastic Aptitude

Wagner (475) made a general survey of the literature on college scholastic prediction. Some of the variables which have been studied are discussed below.

High-school grades—Investigators are generally agreed that better prediction of college achievement, theoretically, may be obtained from high-school marks than from intelligence tests, and, in fact, several studies have obtained the highest correlation from them. Among these studies are those of Crawford (384), Douglass (392), Edds and McCall (396), and Schleier and Schreiber (447). This is exploiting the reliability of marks at different ages, and so, presumably, as the reliability of marks in both schools is improved, the limit will approach the corrected-for-attenuation coefficient, whose limit presumably is 1.00 when the curriculums of the two schools are identical but couched at different levels of maturity.

Such use of high-school marks in a given college, where the students come from many high schools, generally implies the transmutation of marks to a common basis. Toops (467) has pointed out that "the two most important reasons why marks are non-comparable, we may guess, are that (a) the distributions of marks are not identical and (b) the intelligence distributions of the pupils may not be equal, even if the former condition obtains." He has therefore proposed the principle that the average marks of all pupils of a given narrow range of intelligence, in whatever high school, shall be transmuted to a common transmuted score. "If one of these schools, say A, be designated as a standard school (it may be a hypothetical school) the marks of all other schools may be transmuted to the basis of the standard school. Thus all marks of all pupils in all schools, having been made comparable with the marks in school A, will be comparable with one another. And, accordingly, it follows, for example, that a college may be built up (compounded) of the past populations of many schools with known (equated) secondary-school success; and these secondary-school transmuted marks confidently may be expected to prognosticate college success very much better than will the untransmuted marks, or the transmuted marks arrived at by any system which ignores the intellectual differences of different schools.

"Eventually the question would arise: 'Should the school be rated on all subjects, or should the "non-intellectual" ones, like manual training, shop, art, and domestic science, be excluded from the averages?' It will be a progressive move when the pupil's transmuted secondary record which goes collegeward is not a 'rank of 5 in a class of 63,' nor even a single transmuted score as described, but instead *several* (italics ours) transmuted scores, saying, in effect, 'On a comparable standard, this pupil is good in science, mediocre in mathematics, and excellent in English.' " Evaluation of patterns of high-school credits and transmuted marks by the process already described would then be in order. Probable success in specific curriculums should be the aim of prediction for the purpose of giving more specific educational guidance than is now feasible or wise, for it is in this realm as observed by Link (420), that the most promise for guidance lies.

Intelligence tests—Many correlations of intelligence tests with college scholarship are reported in the literature. In recent years, most of the correlations in representative studies range from .50 to .65 (378, 387, 434, 464, 474).

Colleges and universities today are being called on much more frequently by business, industry, and school for the intelligence records of university students. If high-school and university scholarship were transmuted to a comparable basis as described above, employers would find these of as much interest as the intelligence tests. One reason for this present interest in the latter is that the use of percentiles in interpreting scores makes them quickly understood by the layman. Another reason is the predominant use of a certain half dozen outstanding intelligence tests.

The early fears of some that the centralized control of test programs would lead to lack of progress would seem to be realized if we judge by the increase in the validity coefficients alone. But the situation appears better on second inspection. After all, the making of better tests is a technical matter, necessitating funds, machinery, and time for the careful item analysis which is required. There is some likelihood that the lack of improvement in validities during the depression is a function of the upward swing in average intelligence of entering college students (458). Since the range of intelligence has decreased, it has required better tests to maintain the old validities.

Another explanation for the rising average intelligence score, less plausible to the writers, is that higher scores are being obtained because presentday students have been "test-broken" through their previous school experiences with objective tests. Many contend that the college students of today are much more serious-minded than those of a half dozen years ago. An interesting corollary of higher selection as to intellect and purpose, is that, with no change in scholastic standards, failing (i.e., D and E) marks should seldom if ever be given.

A notable application of intelligence tests at the university level is that of standardizing the marking system of individual college professors as described by Ogan (433). The individual intelligence scores and marks of his students in other courses are used to help the instructor to determine whether or not his grading standard is relatively low or high. Whinery (476) has also used intelligence scores as the basis for determining the relative difficulty of courses and for making comparable the marks from course to course.

Achievement tests—Validities comparable to those obtained from intelligence tests have been reported from various subjectmatter tests such as the Iowa Content Examination (473), the Kentucky Classification Test (434), and the College Entrance Examination Board's test (376).

Study time—Although May (425) found, several years ago, a distinct relationship between degree of application as measured by reported study time and scholarship, later studies have failed to confirm this finding. Hartson (402), for instance, found a correlation of –.15 between estimated hours of study and grades. L. Jones and Ruch (412) reported one of –.28. In both studies the improvement in prediction is negligible when this measure is combined with intelligence scores. One reason for this lack of relationship is that students do not estimate their study time correctly. As revealed by Stokes and Lehman (456), the poorer students tend to overestimate their time more than do the better students. The less able students, on the whole, compensate somewhat by studying more and, possibly, by electing a larger proportion of easier subjects.

Personal data—With few exceptions, personal data have proved to be of little use in prognosticating college achievement (372, 457). Age at entering college, however, has generally been found to have a significant negative correlation with college grades (384). Age, however, is simply crudely reflected intellect.

Personality characteristics—A field of investigation in the college area which is demanding attention is that of the more adequate measurement of attitudes, interests, and motives. A few scattered studies have been made for the purpose of predicting college grades. Hartson (403) found that a blank for recording student interests had validities of .365 and .231 for men and women respectively. Holcomb and Laslett (406) found a validity of .322 in predicting the grades of freshman engineers from engineering scores on the Strong Interest Blank. Segel and Brintle (452) reported a marked relationship existing between vocational interest scores on the Strong Interest Blank and differences between marks in college subject groups, as well as differences between achievement test results on the Iowa High School Content Examination. Scores on such blanks have been found to be easily faked, making them of value only in case the answers are bona fide. Investigators have found that interest and attitude scales validated on one group frequently lose most of that validity when given to other groups (393). The American Council on Education record system calls for a careful cumulative record of specific interests. However, such records, desirable as far as they go, do not readily admit of any but subjective interpretation, although the trail has been blazed by Bradshaw (374), who showed several years ago that "behavior specifics" are of far more value in character measurement than the scores derived from any character rating blank or scheme.

Combinations of various measures—The multiple correlation coefficients based upon the best combination of a number of prognostic measures were reported by Wagner (473) to be .67 for the investigations reviewed. Crawford (384) reported validity ranging from .68 to .74 based on a combination of transmuted high-school scholarship, College Entrance Examination Board averages, scholastic aptitude test scores, and age at entrance. Hartson (403) obtained a validity of .68 from the use of five tests. Byrns (378), Edds and McCall (396), and Douglass (392) reported multiple correlations of .63, .81, and .64, respectively. These are encouraging when viewed in the light of the .35 and .40 which typified the validity of Army Alpha some fifteen years ago.

Scholastic Aptitude in Specific Fields

The reader is referred to Wagner's review (475) for studies on the prediction of achievement in specific subjects. Wagner's own work (474) along this line is notable.

Prediction in various curriculums is taken up below:

Dentistry—Schultz (448) investigated the relationship of performance on the Miles Two-Story Duplicate Maze and on the American Council Psychological Examination to the success of 90 second-year dental students in their courses as measured by eight different criteria. A score of maze adaptability produced the highest validities, the correlations being from .247 to .372 with the various criteria. Keller and Weber (414) reported on a battery of tests which all persons seeking to prepare for the dental profession in Germany must take.

Engineering—Of the tests which Holcomb and Laslett (406) tried out, the highest validity in predicting grades of first-year engineering students was found to be that of the American Council Psychological Examination with a correlation of .555. Other correlations were as follows: McQuarrie Mechanical Aptitude Test, .478; the A-S Reaction Study, –.41; Stenquist Mechanical Aptitude Test No. 2, .428; and engineering scores on the Strong Interest Blank, .322. No combination of the scores of the different tests was attempted. Grades in freshman mathematics and freshman mechanical drawing courses were found by Wilson and Hodges (477) to correlate .42 and .406, respectively, with grades in advanced engineering courses, while the validity of the Otis Advanced Intelligence Scale was .382. A multiple correlation of .69 with grades in advanced courses was obtained for four variables: grades in three freshman courses and the Otis test.

Law—The Ferson-Stoddard Law Aptitude Examination was found by Gaudet and Marryott (400) to be better than freshman grades in predicting grades in law school.

Medicine—Moss's reports (430, 431) on the use of his scholastic aptitude test for medical students, based upon a four-year study of 1,000 students and a three-year study of 5,000 students, concluded that "the aptitude test scores give a somewhat better prediction of what the student can do in medical school than any other single one." Cowdery and Ewell's study (383) of 45 first-year medical students confirmed this assertion. The Moss test correlated .636 with grades in medical school. When the test and premedical grades were combined, the correlation was .764 with medical school grades.

Music—In a careful study by More (429), fifteen group tests of musical ability (ten being standard tests and five being new ones devised by the investigator) and an intelligence test were given to all entering freshmen of the School of Music of the North Carolina College for Women for the years 1927-30. A multiple correlation of .73 was obtained between college freshman marks in music courses and the four tests of the finally selected (arbitrary) battery. Stanton (453) found that a battery of tests of musical ability given to freshmen predicted successful graduation.

Nursing—Rosenstein (446) and Frankford (399) both found a relationship between intelligence test scores and trainability of student nurses. The former reported that 75 percent of those individuals dropped from the training school for scholastic reasons were below the 50th percentile on the American Council Psychological Examination. However, when he compared high and low groups selected by this test, he found practically no difference between the two groups on efficiency ratings in practical work. An extensive study by W. B. Jones and Iffert (413) of 777 students revealed a nursing aptitude test to be most highly related to their efficiency record, with the psychological examination a close second.

Teaching—The scores of 135 senior and graduate students on the Coxe-Orleans Prognosis Test of Teaching Ability were compared by Dodd (391) with scholarship and with supervisors' ratings of teaching ability at the close of the practice-teaching period. Correlations of .425 with supervisors' ratings and .636 with scholarship were obtained when raw scores rather than weighted scores were used. Part II of the test—a true-false test of professional interest—had a larger correlation (.454) than the entire test with supervisors' ratings.

As a general criticism of studies on aptitude it may be said that most of them make two probably rather invalid assumptions:

1. The aptitudes required for *learning* an occupation are the ones required for its successful *plying* later.

2. The judgments (mainly or solely) of supervisors and overseers are inadequate measures of the success which the tests were designed to anticipate. Regarding the latter point, Bowman (373) has shown that probably all of the teaching aptitude tests thus far devised, numbering many dissertations, are largely useless because no group of teachers in such an investigation has ever been rated as to true "teaching ability."

Mechanical aptitude—This subject has received relatively little attention since the researches of the Minnesota group and Cox.

Clerical aptitude—O'Rourke (435) conducted an extensive research on the development of tests for the selection of stenographers and typists in cooperation with a number of industrial firms. Correlations of .71 and .76 with efficiency ratings were reported for employees in two different companies. The National Institute of Industrial Psychology (428) used its clerical test, consisting of seven parts, in the United States. Correlations of .87 and .94 are reported for two small groups of 18 and 28 respectively!

The Minnesota Clerical Test, a test of 800 items involving name-checking and number-checking has been developed by Andrew, as reported by Pond (441). It correlated .65 with ratings based upon personal history items, and .37 with supervisors' ratings of 138 clerical workers. The retest reliability was found to be .86. That the author was successful in getting a measure relatively independent of intelligence is shown by the low correlation of .25 with intelligence. Further experimentation has demonstrated this test to be the most sensitive of a number of clerical tests in distinguishing the various grades and classes of clerical workers and in differentiating between employed and unemployed clerical workers (370). A correlation of .65 between ratings for 54 clerical workers in a mail order house and scores on a test for ability to add was reported by Kinney (417). Pond and Bills (440) have found a significant relationship between intelligence test scores and grade of clerical work engaged in.

Miscellaneous—Diehl and his associates (390) found that of the many variables investigated, only name-checking, number-checking, and physical defects were related to captains' ratings of policemen.

Lovett and Richardson (422) reported on the significance of various types of test material in distinguishing sales ability and sales managerial ability on the basis of an item analysis of a test battery of about 900 items.

The problem of eliminating incapable automobile drivers has been receiving a good deal of attention all over the world, but most articles on the subject are discussions of the need for some method of spotting the dangerous drivers, or of the kind of tests which *might* be useful. A few experimental studies are reported in the literature. Miles and Vincent (426) found a correlation of .77 between driving efficiency and the test for motor drivers conducted by the National Institute of Industrial Psychology. Forbes (398) reported the use of an apparatus which reproduced in miniature in the laboratory the conditions of driving through traffic. Thirty-one commercial drivers and fifty university students were tested. The test had some discrimination in picking out the accident-prone commercial drivers from the others.

Bingham (371) reported a study of twenty-four variables in relation to accident-proneness of street-car motormen and bus operators of the Boston Elevated Railway. Accident-proneness was found to be associated with lack of aptitude, personality defect or uncooperative attitude, and health defects. Application of the resulting selection method effected a decrease of 43 percent in collision accidents over a period of four years.

Accident-proneness may be considered as the tendency to have accidents. In this field, Henig (404) found that the more intelligent boys in a trade school had fewer accidents. Farmer and his associates (397), however, did not come to the same conclusion in their study of dockyard and R. A. F. apprentices. They did, however, find some relationship between accident rate and performance on their tests of sensory-motor coordination.

Studies and discussions on aptitude for the occupation of aviation pilot are reported from France, Italy, Spain, Russia, Argentina, and the United

States, but few give objective results. DeFoney (388, 389) reported a study of 628 individuals who were given a psychological examination previous to training as pilots. The low group, given training in spite of their low ratings on the examination, had a "crash rate" twice as great as that of the men who had high ratings.

Test Administration

Effect of long test periods—The question of whether or not long test periods result in a loss of efficiency led to a study by Noll (432) of students taking a three-hour battery of tests. Performance on the Peterson Uniform Equation Completion Test was taken as the measure of efficiency before and after the main test period. The students were found to be slightly more efficient after the testing than before.

Time-limit versus work-limit—Workman (479) and Porter (442) found that administering the Ohio State Psychological Examination by the work-limit method produced higher validities than the time-limit method in the prediction of college scholarship.

Efficiency test forms and scoring methods—J. C. Peterson and others (437, 438, 439) have been prolific in the matter of producing efficiency methods of test scoring. Their methods call for answer sheets separate from the test proper. One method of scoring consists of punching holes through batches of tests in the correct answer position; scoring is then a matter of counting correct answers as indicated by the perforations. Another type of answer sheet is treated so that heating the test brings out a sympathetic ink which has been printed on the correct answer positions. Still another, useful for self-scoring test use, is made so that when the subject dabs the intended answer position with a piece of moistened felt it turns blue if the answer is correct and red if it is wrong. The characteristic of an immediate check upon the student's answer makes this kind of test a promising one for use in the learning situation.

The Clapp-Young Answer Booklets are sealed answer folders with carbon applied inside so that when the subject answers a question correctly an "X" is registered in a square. Scoring then becomes a matter of opening the blank and counting.

A scoring machine which quickly scores each test, prints the score on the test, indicates the wrong answers, and makes a record of the number of times each item is missed, has been invented by Pressey (443) and Little (421). The subjects use hand-punches in indicating their answers on the answer card. In the classroom situation, students' tests are scored as soon as they are completed. When everyone is through, the instructor is able, by looking at the item record, to discover the items on which the most errors were made and to discuss them immediately.

"Krexit" is the trade name of a machine which is used to print red circles in the correct answer position on the answer cards after test has been taken. This is similar to a method used by Toops for printing-press scoring which blocks out all the incorrect answers. Scoring is reduced to the operation of counting the number of right answers.

Cuff (386) developed a device for scoring answer pads in which the subjects have indicated their answers by punching holes in the answer sheets with pencils. Small metal cylinders are dropped through the holes and weighed, the author reporting that speed and accuracy of scoring by this method are much greater than when scorers count the right answers.

A test booklet which is particularly well adapted to large-scale test programs has been developed by Toops (464). The Ohio State University Psychological Examination Form 18 has been so devised that the answer pads may be removed and attached at will, allowing the test proper to be used many times, and bringing the per-pupil cost of a testing program to a very low figure. The test subjects use pointed styli for piercing the test pad to indicate the intended answers. The test pads are then taken apart, yielding three identical pre-scored copies for each subject. These copies serve as records of the students in offices of the principal, superintendent, and central research bureau. The tests may be easily scored by the pupils themselves since the correct answers are indicated inside the answer pad, and since each copy of a given pupil's three answer sheets bears no means of identification other than a common printed individual serial number. Accordingly, when a given pupil's three sets of answers are reassembled the teacher may easily check all three records, which, agreeing, render unnecessary additional official scoring, and supply three correct scored copies for as many different offices.

Summary

Several heartening signs of vitality are apparent in the aptitude testing field. One of these is the growth of cooperative statewide testing programs directed toward measuring the achievements and capacities of young people in order that they may be aided to the most effective individual development. The follow-up and evaluation of the results of experimentally-controlled testing and guidance programs are equally significant of the times. Another is the effort toward obtaining more adequate criteria of occupational success through defining more specifically the objectives of education, and through the development of more valid measures of industrial success. Still another is the marked progress being made in the matter of more efficient test forms and administration.

A number of characteristics of aptitude testing when weighed in the scales are found wanting. Developments in the field to be particularly desired are the use of more adequate methods for combining tests and test items, the use of standard groups for reporting validity and reliability in order that published coefficients shall be comparable, and the interpretation of test scores in terms of the individual's position on his own growth curve. The literature bears evidence to the fact that the problems are coming to be appreciated and that we may hope for their eventual solution.

CHAPTER IV

Test Construction and Statistical Interpretation

RECENT PUBLICATIONS show a growing interest in and dependence upon statistical method. Educational research cannot go full steam ahead until the main body of the profession has acquired at the very least the mathematical and statistical competence necessary to understand the appearing contributions.

Teaching of Statistics

Rather than further indulging in the popular pastime of disparaging the amount of mathematics necessary for educational research, attempts are now being made, notably by Brown (492), to determine the precise mathematical difficulties under which students of education taking statistics labor; and to escape these difficulties by a "psychological" text, embracing a series of self-scored diagnostic tests intended to determine and guide the student's specific needs for review and covering the essential mathematical topics (605). Walker and Durost (606) also sensed the need for three-dimensional models for the teacher's aid in making clear the concepts of statistics. Camp (495), a mathematician, has produced an excellent text on the essentials of mathematics for the study of statistics which does not presuppose a mathematics major preparatory to its study.

Estimates

The estimation of results is a well-recognized part of a good statistical training in order that one may not accept erroneous and ridiculous results, the product of computational error. That estimation can be reduced to a science was shown by Walker and Sanford (604); and that in certain cases estimation may replace actual computation was shown by Scates and Noffsinger (570). It would be quite worth the while to have the topic developed carefully in all its branches.

Patterns of Traits

Perhaps the most significant recent trend in statistics, in the reviewers' opinion, is the growing appreciation that all the factors entering into the educational business—human traits, educational environments, educational results, and educational costs—are not separate and isolated variables but more accurately may be represented by profiles. We must speak of patterns of ability (see Chapter III); environmental patterns; educational-result profiles; and patterns of student costs. The clinical analog is "types." But "types" have several difficulties, not the least of which is the "word-handle" difficulty. Each type had to have a name—for the requirements of language seem to demand such—and either over-simplified human personality if only a few patterns were named; or, venturing in the other direction, were laughed out of court because of the multiplicity of names originated and the inability to specify, precisely, of what traits a given type was compounded. The statistical difficulties have been largely solved by Toops (595) who proposed a system of addends, mathematically derived, whereby each one of all possible patterns of profiles may be coded (and readily decoded) by a single unique code number. Accordingly, whenever the traits of personality shall have been analyzed into the half dozen, more or less, unique traits of which personality is compounded, we shall be able to talk of a person whose profile number is 318. Such a person differs from a person of profile number 317, say, just one degree (say tertile) on one of the unique tests. In wholesale statewide or nationwide testing many persons of each such profile number will be located, and these, later occurring in many "natural experiments"—going to college, getting married, becoming college professors—will yield each their several "probabilities" of "success." Accordingly, it may be safe to prophesy that we may expect shortly to see more of this "single variable" type of experimentation.

The psychologists and test-makers are not alone in their interest in patterns of human ability. The sociologists, interested in the traits and the resulting behaviors of societies, are beginning to see that "like-constituted" groups may be expected to have "like-behaviors." Burt (494) devised a machine, essentially a counting Findex, called the selecto-meter, to locate, in a peg-represented list of persons, these like-constituted individuals. Beyle (488), a political scientist, has devised technics for sorting out the "like-minded" individuals among a group of congressmen, so that their future voting may be anticipated on the basis of their "attitude types." There is more than a faint suggestion that congressional speeches might be dispensed with, not to mention the actual mechanics of voting, if we could knew, in all their statistical ramifications, just whom we had voted into office last November!

Brolyer (491) raised a fundamental question when he asked, and solved, the query, "How reliable is a profile?"

The selection among profiles of human ability which the occupations, progressively with time, effect, has been attacked by B. J. Dvorak (513). This publication is another evidence of the growing awareness among research workers that the composition of groups in terms of profiles, and of greater groups in terms of their component lesser societies, each with its component traits and patterns of individuals, is a profitable field for exploration. Thus far the societies to which a man belongs have been left out of our regression equations, which, moreover, are representations by man's ability rather than *a* man's.

Statistics of Crowds and Societies

The statistics of groups, crowds, and societies, in the light of the traits of the individuals of which such are composed, are in the main yet to be developed, although the basic formulas have been available for some time and occasionally are rediscovered or given a new twist, as in a report of Horst (535).

Equational Representation of Aptitude

The sensed inadequacy of the basic technics have given rise not only to such developments as the above, but have given rise to doubts as to the adequacy of the simple regression equation concept, which long has been under fire, particularly on the part of those more influenced by poetic, philosophic, or clinical case history zeal and considerations than by the rigorous demands of statistical logic. Such criticisms eventuate in little that may be put to a statistical test until such a concept can be couched in the form of an equation. Kelley (541) and Toops (592) have advocated regression equations of the multiplicative order, i.e., involving *products* of test scores in place of their weighted additive *sums* as in the ordinary regression equation. These, when applied to the problem of predicting college success to date have not worked a revolution in the validity coefficients (528, 565). Such are at least one answer to the criticism of Johnson (540) who deplored the use of additive regression equations only. Such an equation may take at least some account of such observations as these:

1. An aptitude may be zero even if all but one of its "determiners" are present and favorable, if that one is of zero amount.
2. Concretely, a student's scholarship may be zero, no matter how bright he is or how hard he studies, if the text is so difficult that he cannot at all comprehend it.

Still more complicated regression equations, readily fitted by least squares methods, have been advocated by Toops (588). Curves involving second powers, for example, have the property of rising to a maximum and then descending, a phenomenon, associated particularly with time, as for example, the well-known phenomenon of the growth of height. Such equations, of course, are too absurdly simple to be maximally useful, and probably we shall make little progress until we begin to employ real growth equations of such a degree of complexity that they stand a fair chance of being a good approximation to the "true" equation. The reviewer hazards the guess that Will's equation (613) is of this minimal degree of complexity, since it has the property of rising to a maximum and then declining to a fixed asymptotic lower limit, a phenomenon often noticed in population growth, a property of crowds analogous with the phenomena of inertia and momentum of physical objects in respect to motion. These physical notions of a society are being developed by Dodd, a psychologist recently turned sociologist.

Factor Theories

The factor technics are attempts to derive an analysis of man's capacities and abilities out of the internal consistency of their interrelationships as revealed in the intercorrelations of test scores. They may be humorously cataloged as an attempt to determine an equation without any equality sign and any left-hand member. These have been the rage of the past few years. The fundamental and earlier contributions of Spearman, Kelley, and Holzinger have been followed with later and fundamental contributions by Thurstone (581, 584, 585, 586); Hotelling (538); Spearman (574); and lately, Wilson (614, 615). The appearance of a new title by any of these is acclaimed with joy by a very small camp of enthusiasts.

The problem of factors is essentially the problem of the above-named analytical technics of patterns, but done by a different attack. So far, it must be acknowledged, the methods, the claims, and the speculations of rival camps, with the exception particularly of the main representatives of the camps above noted, have resulted in little other than excuses for magazine articles. Certain notable exceptions are Thurstone's analysis (582) of the fundamental interests of man; Moore's analysis (549) of the fundamental syndromes of the insanities; Reinhart's (561) and Asher's (484) attempts to derive an actual intelligence test by the use of factor technics; Anastasi's analysis (483) of memory; and Dunlap's analysis (510) of the learning of chickens.

If factor theories cease to be a religion and become a statistical technic they promise much assistance in the analysis of causation of human behavior; in important applications in test-building and aptitudes; and aid in the direction generally of learning, motivation, and social ameliorization so far as these can be effected through control of the human variables.

Analysis of Variance and Covariance

A different angle is the analysis of variance and covariance, a method favored by Kelley (541) and Snedecor (573). Causality has been treated abstractly by Dunlap and Cureton (509) and with respect to mental life particularly by Moore (550).

Wholesale Computation of Intercorrelations

The factor theories and analysis of causation require, generally speaking, all the possible intercorrelations, means, and standard deviations of n variables, where n may be quite large. Accordingly, we see much interest in tabulating machine methods of obtaining the host of moments necessitated. The first monograph (608) of the Columbia University Statistics Bureau has become a classic. It is fair to predict that the recent text (485) on the application of Hollerith machines is but a forerunner of a new day in statistical computation, and a sign that eventually a host of basic reference works will follow. Dunn (511) has devised a method of punching as many as 80 variables, each of 4,095 inclusive range, into a single Hollerith card, or a corresponding number of other punch-card equivalents, e.g., 240 variables of 15 scores each. Royer and Toops (568) have shown that these 240 variables may consist of 15 *coded* scores, thus fixing the limits of presentday statistical machines at 240 variables, each of *unlimited* range. They have also developed the mathematics of the method. Before inclusive growth studies of all the varied functions of an individual may become feasible we shall have to render unlimited not only the number of persons and range of scores, but also the number of variables per person.

Printed Correlation-Solving Forms

Three new printed correlation forms have appeared, prepared by Cureton and Dunlap (503), Smeltzer (572), and Tryon (600); five variations in methods of correlation-solving, by Chapin (496), Constance (498), A. Dvorak (512), Feldstein (516), and Stephenson (576); a method for solving the standard deviation by stencil by Toops (589); a method for solving mean square contingency by Royer (567); a stencil-method of fitting straightline trends, regression of Y on X with one plot per X-unit, by Toops (591); several methods for simplifying the computations of partial correlations, multiple correlations, and multiple regression equations, by Bakst (486), Franzen and Derryberry (518), Peters and Wykes (559, 560), Thomson (579), Griffin (525), Horst (533, 537), Wherry (610), Brolyer (490), and Adkins and Toops (481). A new least-square curve fitting machine, for fitting straightline trends, or logarithmic equations in the linear form, has been devised by Gaines and Palfrey (519); and their use of the correlation coefficient to compare the efficiency of their machine with the ordinary algebraic methods has been criticized by Berkson (487). A machine for the solution of determinants up to the tenth order has been invented at the Massachusetts Institute of Technology, an institution already famous for its tide-predicting, integrating, and other complicated mathematical machines.

Research workers have become nomograph-conscious since the publication of Dunlap and Kurtz's classic *Handbook of Statistical Nomographs, Tables, and Formulas* (508). Other contributions to the literature have been made as follows: for standard errors of differences, by Edgerton (515); for Blakeman's test of linearity, by Griffin (522); how to construct a nomograph, by Griffin (521), and a text by Allcock and Jones (482); for the coefficient of part correlation, by Griffin (524); for the Brown-Spearman formula, by Griffin (523); a book of charts for computing tetrachoric r, by Cheshire, Saffir, and Thurstone (497); and for the standard error of biserial r, by McNamara and Dunlap (544).

Tables

Tables for facilitating computations appearing in the past three years include: general statistical tables for students of educational statistics, by

Holzinger (531); Part 2 of Pearson's *Tables for Statisticians and Biometricians* (557); tables for inter-percentile ranges, by Masters and Upshall (545); and for log $(1-r^2)$ ½ useful in partial correlation, by Mori (551) the text being in Japanese, the tables in English.

Slide Rules

Slide rules have been much in evidence, also. There are three for calculating ages: two by Constantine (499, 500), the second giving ages to days, and one by Yepsen and Dunlap (616), giving quotients for I.Q.'s as well. A generally useful statistical slide rule was developed by Dunlap and Kurtz (507). Heinemann (530), in Germany, discussed experiments to note the comparative excellence in use of four styles of slide rule, and voted finally for "simplicity."

Matched Groups

A formula has been developed by Peters and Van Voorhis (558) which makes allowance for the coefficients of reliability in computing the standard error of the mean. The formula, $\sigma_M = \frac{\sigma_x}{\sqrt{N}}\sqrt{1 - r^2}$, approaches zero as the reliability of the measure used approaches unity. In the case of zero reliability, the correction for reliability disappears (becomes unity) and the formula reduces to the usual one for the standard error of the mean.

This property is particularly important as revealing that much smaller than usual critical ratios are, under the conditions implied, "statistically of significance." The article is taken from the chapter on reliability of a statistical text promised for early appearance from the Pennsylvania State College Press.

A similar formula reported previously by Wilks (612) and Lindquist (543), allows adjustment for the correlation between the variable, on which groups are matched, and the variable being studied. The correlation between the two variables, r_{xy}, is used in the above equation instead of the coefficient of reliability. When used in obtaining the standard error of the difference of means, use of the formula eliminates the necessity of laboriously matching individual with individual, but requires only the equating of groups on the basis of means and standard deviations. It also allows the use of groups of unequal size.

Rulon and Croon (569) described a method of eliminating cases from different groups so as finally to obtain groups with equal means and standard deviations on the measure on which they are to be matched.

Probable Errors

Cureton (504) published an epochal monograph on the probable errors of many of the constants most used by educational workers. Other probable error formulas recently devised are: standard error of a multiple regression equation, by Miner (546); of a tetrad in samples from a normal population of independent variables, by Wilks (611); of the average intercorrelation and of the average criterion correlation, by Cureton (505); and also of the Spearman-Brown formula (506).

It remains to be seen whether big-scale research, with its tens of thousands of cases, will make probable errors unnecessary, or whether we shall go to the other extreme and try to conduct our experiments with hardly any cases at all. Fisher's treatise (517) on small sampling theory has become a classic for the biologists, agronomists, animal psychologists, and others who cannot well afford to indulge in statistical sprees of hundreds of thousands. So likewise has become Shewhart's study (571) in the eyes of manufacturers who cannot afford to demolish even one $100,000 machine to guess whether the remaining nineteen ordered by a customer will work or fly to pieces. Certain it is that a probable error seldom—much more seldom than should be the case—has been used to control the course of educational experimentation. Usually such coefficients have been calculated for publication as an afterthought, on the insistence of the embryo Ph. D.'s major adviser. It is well known that the famous dictum, "If you knew the history of a single tree you would know the history of the universe," was intended for rhetorical effect rather than for practical application. Nevertheless, our analysis of causation and our notions of reliability are bound up in our notions of the causes, sources, and amounts of error. It is hopeful, as well as humorous, that a new *variety* of error is announced monthly!

Scoring Formulas

The new test-scoring machines and test forms in themselves have not led to any new formulas, and it is axiomatic that a new formula in time leads to a host of new concepts and practices. Motivated by the development of such devices, however, we have a promise in the coding methods developed by Toops (595), and their accessory formulas, not only of painless test-scoring and regression-solving (using scoring books), item analysis, and multiple-choice-alternative-weighting, but also of a basic attack upon the problem of profiles of human ability.

The Strong Interest Blank has been revised in its scoring-method and adapted to Hollerith machine scoring (hand selection of the recorded responses) by Strong and Green (577); and the International Business Machines Company (485:19) have devised an attachment for their tabulator making pre-sorting of the cards unnecessary. Stagner (575) devised a mimeograph *additive* method of weighting tests for which multiple regression weights are available. Negative weights are overcome by adding a constant of sufficient size to each WX product to render all positive, and this is finally corrected for (subtracted out of) the constant term of the regression equation. The method has been adapted to the multiple-ratio technic by Toops (594).

Criteria

The obtainable validity of tests is limited by the reliability and validity of the criterion used. Since the classic treatment (556) there have been several basic contributions. Thorndike and his associates (580) employed wages, job satisfaction, and level of work attained as measures of occupational success. Hoppock devised a scale for measuring job satisfaction. Richardson and Kuder (564) used a checking of "specifics" blank, evaluated by the Thurstone attitude scaling technic as a substitute for supervisors' ratings in deriving a criterion. The employment of these will improve the criteria of the future. Easley (514) pointed out the increased reliability of long-time samples as versus short, and the possibility of greater validity thereby attainable. We cannot escape the need for more samples of our criterion. Turney (601) pointed out that a number of short tests have a cumulative reliability. The reviewer suspects that many short tests have the property of keeping effort at a maximum, so that the final examination more nearly reveals the true ability of the student. If study time be reduced to a constant, as at West Point, the validity of intelligence tests jumps markedly as shown also at Yale (556). This, in connection with Courtis' observations (502) regarding the hodge-podge nature of our measurements and particularly our disregard of the *intent* (motivation) of the testee, suggests that our criteria are hodge-podges that could not be expected to be predicted well by any tests, however good.

The problem in its essence is "What constitutes success?" It is clear, then, that practice in this realm will be benefited by whatever advances are made in factor theory, causation, variance, and patterns of traits. Edgerton, in an unpublished manuscript, proposed to find that system of least-square weights for the several criterion components, or variables, which, with a similar series of weights for the several tests of the test series, will maximalize the correlation between the two sides of the equation.

Hotelling (539) solved the same problem by an appeal to a type of mathematics which will be unintelligible to most readers of this review. Whether the problem is answered philosophically by these mathematical solutions is an open question. Success *is* a profile. And when John Citizen, now prognosticated to be of average aptitude for occupations A and B, is faced with the alternative of choosing between A, in which he is predicted to be fast but inaccurate (therefore averaging out to mediocre), and B, in which he is predicted to be slow but accurate (again averaging out to mediocre), may greatly prefer to choose the latter in preference to the former. It is only, or mainly, for wage-payment purposes that we require a unitary criterion rather than a profile. And when it is realized that wages are a means rather than an end, even wages may be paid on the basis of a profile of need: so much for food, so much for recreation, so much towards the publication of a book—whatever are the purposes of the recipient which wages may foster into a more abundant life. We, too, no doubt would pay our debts more gracefully if they were detailed (a profile), so much of taxes, for example, for police protection, so much for water-main repair, etc., instead of the uninteresting lump sum, "Taxes for six months, ending June 30, $100."

Ratings

Swab and Peters (578) showed that pupil estimates of fellow-pupils have considerable validity in the case of estimating age, height, and marks in arithmetic, but do rather badly in estimating brightness. The reliability, for 30 cases only, ranges between .95 and .99 for six traits. These results suggest the employment as a research procedure of pupils' judgments of pupils. Remmers (562) and Adams (480) suggested inserting in rating scales judgments of objective qualities such as length and weight as a means of measuring and eliminating halo and of measuring the effects of and giving practical meaning to such concepts as accuracy, error, and reliability. This is an improvement over Thorndike's practice of inserting, say, beauty, as a joker to test the presence, but not very precisely the amount, of halo.

Criteria may be improved by such methods, employing these technics to test, pick, and choose (or weight) our judgments, analogous to the several technics now being used to select, discard, and weight tests, subtests, and items.

Reliability and Validity

In a similar attempt to improve reliability we have the well-known methods of (a) lengthening the test; (b) interviewing and cross-questioning the experimental subjects regarding their failures on individual items; and (c) working for internal consistency of the items by statistical means. We might hazard a guess that factor theories ultimately will be found useful here. The method of lengthening the test naturally languishes since the trend of the times has been towards shorter tests (results being equal), and since it is thought by competent people that it is more meritorious to work for greater validity and allow reliability to shift for itself. Employing this principle, the method of interviewing has been used by Valentiner (602) in making tests more valid. A method, called the L-method, of shortening a test while maintaining its reliability (equally applicable to making a test shorter while maintaining its validity or to the construction of alternative forms of test) was devised by Toops (596) and used by Royer and Toops (566) and by Hartson (527) for picking tests and sub-tests of the greatest in-combination validity, as an alternative to multiple correlation procedures. Its basic concept is that a feasible or *practical* test must have the elements weighted with *equal gross score weights*; and the necessary formulas, involving in effect the intercorrelation coefficients (actually the gross score intermoments), are deduced and applied to that problem. The process works by the build-up-a-scale process, quite the converse of multiple-correlation methods where enormous regression equations must be solved and the tests (or sub-tests, or items) of low weights then must be discarded.

A text in the combined field which bids fair to become a classic has been written by Thurstone (583).

Item Study

The validity of a test, as well as its reliability, is conditioned by the items of which it is composed. That an item has validity, difficulty (mean score or percent right), and even reliability, puts the item in the same statistical category as the test or sub-test, with the added advantage that, existing in two degrees only (Right = 1; Failure = 0), it admits of the application of various probability and other technics not applicable to multi-categoried test scores. These technics have been reviewed recently by Osburn (555).

Transmutation

Heilman (529) achieved a transmutation of test scores by correcting for differences in mean, but not for differences in standard deviation.

Toops (590, 599) raised the issue of translating, by means of the regression equation—which corrects for both—high-school marks obtained on university students originating in many high schools. He proposes to employ transmutation equations computed individually for each high school of a state, the principle being that pupils of like intelligence (or of a common score on tests of capacity or attainment) should be transmuted to the same transmuted mark, no matter what the marking system. This corrects not only the marks of the average pupil, but differentially those of either extreme as well. It ignores motivation and quality of instruction by assuming these equal in different schools for pupils of like intelligence. Ogan (553) established the principle that both a pupil's intelligence and his marks in other subjects should be used to determine whether a particular instructor has the "proper" distribution of marks, thus equating for both intelligence and motivation so far as the latter is measured by "marks in all other courses but this." By such means criteria will be improved.

Horst (532, 534, 536) published three articles on the matter of obtaining comparable scores in distributions.

Toops (594) contributed a method whereby qualitative data may be quantified and then employed in regression equations as readily and as meaningfully as strictly quantitative data. The principle is that categories must be quantified by assigning to each, as a transmuted score, a quantity proportional to the average criterion score of the category in question. The same principle rectifies curvilinear regressions. Bingham (489) suggested that qualitative data may be accorded a transmuted score which is the percent of those individuals of the category in question who attain "success," this being arbitrarily defined as a "passing point." All of these indicate a healthy striving for "the proper units" of measurement.

Norms

Courtis (501) pointed out that norms are all but meaningless unless we take into account the characteristics of the individual's growth curve. As an extreme illustration, a person growing at a normal rate, one year of mental age per chronological year, and therefore destined ultimately to attain a normal adult intelligence, may get a late start and so year by year improve in I. Q. As a corollary, an I. Q. of an individual cannot be ascertained by one measurement alone, three being the very minimum necessary.

O'Rourke (554) pointed out that the proper norms (standard scores), based on the groups in industry with which a pupil later will compete, are essential to the construction of profiles for guidance purposes.

Technics of Selection

The line between guidance and selection is always a thinly drawn one. That the two are not necessarily incompatible if we look at the matter from the educational statesmanship view, was shown by O'Rourke (554) and by Toops (590, 593) who (597) also pointed out the dangers of the at present much used and much abused successive hurdles method of selection. By transmutation of marks and collection of other to-be-had-for-the-asking variables the seniors of the high schools of a state may be ranked on a scale of college aptitude which will be most useful in college recruiting, and, if wisely done, serve the ends of good guidance, since college is one of the "opportunities." The necessity for a measure of "financial need" is pointed out.

Standardization

That statistics is difficult because of its lack of standardization of symbols and formulas was shown by West (609) and Yntema (617). Monroe (548) proposed that a certain list of statistical symbols be regarded as standard; while Toops (598) proposed standard codes for coding qualitative data, and transmutation equations for quantitative data.

Novel Applications of Statistics

Reymert (563) used the bids technic to create a scale for measuring the ability of the psychologists of the several colleges of a state. Ward (607) used the multiple-ratio procedure to ascertain the salary formula of a college faculty as a means to setting up the proper faculty record forms. Burgess (493), Glueck and Glueck (520), Tibbitts (587), Vold (603), and Monachesi (547), sociologists, employed the traits, environments, and treatments of prisoners as "presence-absence" variables, reversed if the correlation were negative, to predict ability to succeed on parole, and obtain validities which should figure out to a coefficient of .50 or better. Kurtz (542) employed the multiple correlation technic to determine the point-values which statistically should be allocated to letter grades in college courses, utilizing as criteria two measures of subsequent success—persistence and graduation—and two measures of previously demonstrated ability—high-school marks and intelligence. Thus, marks of A, B, C, and D may be accorded positive weights of 4, 3, 2, 1 without much error, from the viewpoints of subsequent predictability and subsequent use as prognosticators of persistence and graduation; but the grade E (failure) must be accorded a sizable negative score if we would properly account for its deleterious effects on persistence and graduation, thus raising an interesting problem in the *motivational* possibilities of marks.

Nanninga (552) fitted exponential curves to his data regarding costs, size, and offerings of California high schools. Courtis (501) devised growth equations and a rotation capable of taking account of superimposed cycles of growth. Gulliksen (526) computed a rational equation of the learning curve based on the law of effect (motivational effect of satisfaction or dissatisfaction), one of the few attempted rational equations of psychology. This, together with Thurstone's earlier logical learning equation, comprises practically all the logical equations the educational psychologist has to show for his labors to date. No treatise on the methods of derivation of logical laws seems to be available, although the month that does not bring forth a new statistics text is rare indeed.

Summary

The high points in statistical development of the past three years are:

1. Definite attempts to improve statistics teaching and statistical reporting, through analysis of the mathematical and learning difficulties of students and through standardization of statistical symbols, procedures, and forms of reporting
2. Introduction of the topic of estimation on a scientific basis
3. A growing literature on profiles and patterns, their representation and significance, a logical development of the recent emphasis upon factor theories, unique traits, and the "elements" of behavior generally (Having the elements at hand, we must compound them. The result is profiles.)
4. The growing realization that the profile, rather than a single index, is the most meaningful way to represent all the "variables" in the educational process—human traits, environments, occupational (including educational) results (criteria), and costs
5. Wholesale, statewide testing programs with their inherent research possibilities of locating all persons of profile number 318 for follow-up study and comparison with those of profile number 317, an alternative to multiple regression methods
6. The possible subsequent utilization of all human experience—"natural experiments"—as criteria
7. The growing interest in the characteristics of a group in the light of the subsocieties of which it is compounded
8. Excursions into the domain of more complicated equations, particularly those in which *time* is a function; and the provision for multiplicative as well as additive relationships

9. The appearance of a few applications of factor theories among a host of theoretical articles on the topic

10. Immense advances in applications of statistical machines to research, and in the means of representation of statistics, and the utilization of qualitative and irregular data (A healthy interest in the units of measurement is noted.)

11. A goodly and much-needed beginning in the theory of criteria

12. Progressive developments in multiple regression solving, in item analysis, and in alternative technics of test building

13. A beginning by two or three persons of the utilization of time in equations and of consideration of the possibility of logical laws in place of empirical laws

14. A growing number of applications of statistics to novel problems.

By way of criticism and suggestion we may note that:

1. Our concepts of success and its measurement by criterion scores are in a chaotic state, particularly the foundational philosophy.

2. The development of logical equations is scarcely appreciated as a need by the rank and file of research workers. No text on the methods of logical derivation of laws seems to be available.

3. Few experiments are ever repeated or reverified.

4. We need equations which shall take account of the effect upon the individual's products (criteria), not only of his traits but also of his associates and environments.

5. We may be lulled into a false sense of scientific security and well-being by the ease with which soon we shall be able to do researches by the available methods, and in our preoccupation with quantity of research may fail to take account of the need for laws and equations which are more complicated but more true to life.

6. There is a danger that the development of small sample theory and the new formulas for unreliability coefficients may be used as excuses by many for slip-shod research on too few cases. The publication of unreliability coefficients (even small ones) does not guarantee the reliability or validity (the dependability) of research.

7. There is a general failure to consider any test score as a cross-section view of a time-growth curve with all its statistical implications.

8. There is a need for the development of statistical machines which shall render unlimited not only the numbers of persons and the range of the variables, but also the number of variables. To treat each of a hundred variables as a growth process, annually measured, will require, say 2,000 variables per person.

9. There is need for the statistical and theoretical development of the topics of transmutation, employment of qualitative data, and statistics of societies in the light of their component sub-societies and individuals.

10. There is need for the theoretical development of the statistical and philosophical relationship of guidance and selection, viewing the problem as a national, or international problem in planning; and for a succinct statement of the statistical theories of selection now implied in such practices as the successive hurdles method of the schools in occupational preferment, the practices of civil service, of honors-granting bodies, and of employment bureaus in industry.

11. We need researches into the salary formulas of schools and industry, a problem growing out of the preceding one.

CHAPTER V

General Survey of the Field of Character and Personality Measurement

IN TREATING THE MATERIALS for the present issue of the *Review of Educational Research*, the writers have taken as a broad basis for division the general dichotomy of implicit and explicit behavior, personal and social, or internal and external. Inner adjustment, interests, and attitudes are represented in Chapters VI and VII. In these divisions we have the person's feelings, emotions, conflicts, and verbalized attitudes toward various issues. It is recognized that these may be independent of, or only partially dependent on, information, and may or may not be expressed in action. All technics of personality study which utilize an external observer have been treated in a final chapter (VIII) under the general heading of measures of information and conduct. In the general division, tests of information concerning laws, customs, and conventions have been treated as overt performance, since they have an objectivity in the external situation. The classification adopted does not, of course, entirely avoid overlapping on the basis of topics, methods, or particular investigations.

The volume of pertinent material in the three-year period has necessitated a selective treatment. An attempt has been made to retain references which illuminate the general issues, develop new technics, or summarize bodies of material. A number of bibliographic summaries, books, and journals have appeared which cut across the plan of division of the report or are indicative of trends which affect the field as a whole. These are described in the present chapter.

Reviews and Books

Watson (634, 635) published comprehensive reviews of the field in 1932 and again in 1933. These have been brought down to July, 1934, by Maller (625, 626), who has also made an intensive three-year study of publications in the German psychological literature (627). A convenient list of character and personality tests and ratings may be found in Hildreth's general bibliography (622). The compilation gives author, publisher, and a pertinent reference to each instrument available up to about 1933. Some of the better known tests and ratings for social adaptation have been listed by the United States Office of Education (630).

Fauville (618) reviewed experimental studies dealing with the structure of personality. His interest was in the mutual relationship between physical, temperamental, and character traits. Jones (623), in addition to a review of the general literature on methods of character measurement, presented a tabular summary of test situations which have been employed for performance, knowledge, and attitudes. Garrett and Schneck (620) devoted one chapter in their general treatise on psychological tests, methods, and results to the measurement of personality and temperament.

Haddock and Ellis (621) prepared a source book for the use of persons engaged in teaching or studying the development of character. The authors give an account of the history of the study of character and personality from about 415 B.C. to the present. The book contains a bibliography of 803 titles and 18 pages of subjectmatter index.

The book by the Murphys (629) on experimental social psychology gave a critical review and discussion of many of the current investigations in social relationships. Murphy and Jensen (628) dealt with a general theoretical organization of personality research, including the approach from experimental psychology, from psychoanalysis, and genetic study.

Symonds (632) prepared an exhaustive treatment of methods for diagnosing personality and conduct. Observations, rating methods, questionnaires, tests, free association methods, and physiological measures were considered. Special chapters were also concerned with the technics of interviewing and psychoanalysis. Judgment of character from physical signs and measures of the environment received consideration. This work was followed by a treatment (633) of character and personality data with particular reference to social adjustment as concerned with criminal tendencies, mental disorders, vocational fitness, and citizenship. A helpful classified descriptive list of tests, questionnaires, and rating scales was included.

The annual summaries of research in progress which have appeared in the *American Journal of Sociology* indicate that the problems of personality in relation to the culture represented a predominant interest of both students (631) and mature investigators (624).

New Journals

The three-year period covered by this *Review* has seen the birth or major development of several periodicals devoted wholly or in part to problems of character and personality. The *American Journal of Orthopsychiatry* (145 East 57th Street, New York City), was begun in 1930. The emphasis of the *Journal* is on clinical approaches to treatment. Practically every issue, however, contains articles based on standardized test situations for measured appraisals of personality or social factors or on the statistical treatment of qualitative items. *Child Development* (Williams and Wilkins Company, Mount Royal and Guilford Avenues, Baltimore, Maryland) began publication in March, 1930. It regularly carries material pertinent to the measurement and development of character and personality in children. The journal, *Character and Personality* (Duke University Press, Durham, North Carolina), was founded as an international quarterly, with the first number appearing in September, 1932. The journal tends to be philosophic and speculative in character, but it is catholic in its range and contains technical reports as well as material which supplies a frame of reference for measurement studies. The *Journal of Experimental Education* (Edward Brothers, Inc., Ann Arbor, Michigan) first issued in September, 1932 has devoted space to a number of articles on observational and attitudinal measures of personality. The first issue of *Character* (Religious Education Association, 59 East Van Buren Street, Chicago, Illinois) appeared in October-November, 1934. This periodical attempts to generalize and popularize technical material for persons who are responsible for programs of action.

Applications

A survey of tests by Fenton and Wallace (619) in twenty-eight child guidance clinic centers in the United States indicated that the bulk of clinical instruments in the field of personality and character represent editions or special scoring methods for the type of personal reporting initiated by Woodworth. This is, of course, the most convenient plan for clinical use since the patient must supply the information. The same general trend was found by Witty and Theman (636) with somewhat greater evidence of the use of tests of the May-Hartshorne type.

It would appear that the development of tests of conduct and information and of systematic observations and ratings in the social setting from which the child comes has affected only slightly the general practices of clinics.

Needs

While we are concerned in this chapter primarily with the present state of research on means of studying personality, it appears well to point out certain avenues of scientific thinking which suggest the need for new directions. While usually ready to concede the technical gains made in measurement approaches, the Gestaltists and psychoanalysts have also illustrated the desirability of a broader theoretical orientation upon which to build research programs which are concerned less with the peripheral responses and more with the internal aspects of the problem. There is need to use the quantitative approaches on the problem of how personality becomes organized in interaction with the culture, and to have more longitudinal studies in which persons are followed over periods of time.

CHAPTER VI

Mental Hygiene and Emotional Adjustment

Instruments for Self-Report

It has been common practice to devise a set of questions (or to modify a set prepared by previous workers) asking subjects to tell of their troubles, their symptoms, their desires, their behavior tendencies, etc. Wrightstone (758) used the oldest, the Woodworth-Mathews, to compare with teachers' case studies of pupils. Thurstone's schedule was criticized by Harvey (676), compared with clinical studies by Hanna (673), and with hospital diagnosis of psychotics by H. N. Smith. Willoughby (756) worked out a short form derived from Thurstone's and published norms. Bernreuter (644) combined questions by Thurstone, Laird (introversion), and Allport (ascendancy), adding scores for self-sufficiency (643) and defending reliability and validity (645). Marshall reported a try-out of the Bernreuter schedule on 371 consecutive patients in a neuropsychiatric hospital, showing the median psychoneurotic at the 80th percentile of the normal population in neuroticism score, the schizophrenics all above the 60th percentile norms on introversion, the manics all below the median in introversion. Stagner (729) agrees. Murray (705) arranged a set of 46 questions which differentiated emotionally maladjusted and delinquent boys (age eleven to sixteen) from controls. Cavan (657) modified this slightly for use with girls and reported a correlation of .6 or .7 with the scale of 24 questions used in the White House Conference studies. Ingle and Barton report giving 150 questions on emotional stability to college students. Whatever 75 percent of the people answered they called the right or "stable" answer, and anyone with twenty or more uncommon answers was labelled neurotic. This is typical of the worst in blind objectivity. White and Fenton (749) found their collection of questions differentiating little between delinquent boys supposed to have inferiority complexes, and normal delinquents. Bell (642) published a new adjustment inventory of 140 questions classified as bearing upon home, health, social and emotional adjustment. Smith's Self-Comparison Inventory (727) seemed to measure inferiority feelings among high-school students with satisfactory reliability. The Presseys (714) revised the X-O to permit scoring for emotional age. They found problem children more apt to fall outside the middle range of scores. Flowers compared the old Pressey X-O scores for 45 psychotic patients who improved enough to be discharged and found no difference between them and the scores of those who became worse.

Maller's Character Sketches (697) with two parallel forms contain statements descriptive of habits, self control, social adjustment, personal adjustment, symptoms of mental disorder, and readiness to confide. The subject tells whether he feels that he is the same (S) or different (D). Reliabilities for the junior high school were found to be over .9. Correlations with Woodworth-Mathews and Thurstone ran about .6. Because of simple language and broad scope, this instrument is probably the best available tool for self-description by pupils of junior high-school level. Results with this, as with every self-report form, must be interpreted, of course, in terms of the impression the subject wishes to give.

Guilford (671) reviewed 115 studies on introversion-extroversion, noting as did Gilliland some low intercorrelations due to widely different definitions of the concepts. New questionnaires set up by Root, Roberts, and Kubo seem to add little. Studies by Stagner and Pessin and by Guilford contain painstaking statistical analysis of introversion-extroversion items. Guilford and Hunt (672) also found the rate of fluctuation of a reversible cube perception, previously suggested by McDougall as an index to introversion-extroversion, unrelated to any other supposed index of these types. Mierke (704) used as an index of extroversion the ease with which a subject, working at a pleasant task with unpleasant colors, would come to like the colors, or working at an unpleasant task with preferred colors would come to dislike the colors.

Manzer (700) reported self-ratings on the Allport Ascendancy-Submission Test to contain the usual distortion toward making a favorable impression. Beckman modified the A-S scale for business use.

Inventories to help make case histories more complete and more objective have been developed by Stefanescu and others (730), Scherke (723), and Patry (709).

The major new technic, so far as self-rating instruments are concerned, has been the applications of factor analysis. Willoughby (754) began with the six constellations Darrow had previously found in the Thurstone scale. In both multiple-factor analysis and two-factor analysis the category called "Fantasy" seemed heavily loaded with the first general factor, while the categories "Sex" and "Parental" showed least. The Guilfords (670) worked out the relationship of each of 36 items to a general factor of introversion. Thurstone's multiple-factor analysis suggested at least 18 group factors. Pallister (708) analyzed a battery of measures (Lecky's 200-question Individuality Record, a vocabulary test on 160 words, a personal data sheet, ten rating scales, and a set of physical measures) to find the relationship of each to a general factor: tendency of the person to withdraw from the environment. Perry (710) gave a battery (Bernreuter, Pressey X-O, Allport A-S, Colgate B2 and C2, intelligence, and achievement) to 300 college entrants. Ignoring the distortion of answers by the conditions under which the questionnaires were answered, he went ahead with correlation, tetrad, and multiple-factor analysis. He found some reason for believing that neurotic tendencies, dominance, and intelligence are independent variables. Present uncertainty regarding the psychological value of the factor-analysis technic would seem to be supported by these studies.

Among other suggestions for advance in technic mention should be made of: Vernon's re-emphasis (739) upon the importance of the attitude of the person tested; Rosenzweig's proposal (722) that the subject be asked not what traits he has, but the question more likely to be truthfully answered, regarding traits he would like to have; and Uehling's argument (738) against questions too difficult and too pointed.

The usual criticisms of self-report measures are:

1. Subjects do not answer reliably.
2. Answers are arranged to make a good impression; this is particularly true of the more intelligent or experienced persons, and in situations in which they suspect that their vocational status may be affected by the outcome.
3. None of the available measures has been built by persons with sufficient clinical experience and insight to permit the instrument to be really diagnostic. Counting symptoms is not diagnosis.

A few investigations relate to these criticisms.

Cavan (658) checked the consistency of answers to a neurotic inventory by repetition within a week. Agreement was reported on 83 percent of the items. Siblings answering questions about their home agreed to the extent of 93 percent on factual items, and 62 percent on estimates. Bain (637) repeated 61 items of personnel information after 2½ months, with identical responses on only 77 percent of the items. Differences between items classified as "factual family," "factual personal," and "subjective personal" were not significant.

Hertzberg (682) repeated the Thurstone schedule after a year in college and found about 80 percent of the students showing some improvement in score. He found the usual zero correlations with intelligence and school achievement, although the "extremely well-adjusted group" both years earned fewer grade points than did groups at any of the four lower adjustment levels.

Luh and Sailer (694) found that self-ratings by Chinese students in China showed the same tendency to over-estimate one's own good qualities which has frequently been observed in this country.

No attempt has yet been made to construct instruments which will show symptoms in relation to underlying causes, patterns, or what Wertheimer calls the "radex" of personality.

Applications of Self-Report Instruments

No dependable results of scientific or practical interest have emerged from the frequently reported giving of some blank or other to delinquents and criminals (e.g., the Bernreuter by Hargan, the Neymann-Kohlstedt by Ball, the Thurstone by Garrison, and also by Simpson) with no controls. Simpson (725) found prisoners exceeding college students on favorable self-ratings. Stevens (732) compared 100 recidivists and 100 college freshmen, finding the former more strictly brought up, more religious, less friendly with father, coming from larger families. Courthial (661) compared 82 delinquent adolescent girls with a much larger control group, equated for C. A., M. A., I. Q., home background score (Burdick test), and socio-economic status (Sims score card). Significant differences indicated fewer acts condemned, more worries (Pressey X-O), more symptoms of maladjustment (Woodworth-Mathews), more cheating (C. E. I. test), more persistence (C. E. I. test), more enjoyment in being alone, stronger preference for boy friends, more parental disapproval of friends, more dates, less family recreation for the delinquent group.

School success has been another tempting goal for prediction by means of symptom questionnaires. Stagner (728) reviewed 45 studies showing almost uniformly low, zero, or slightly negative correlations between favorable personality report and school achievement. His own correlation of grades with the Pressey X-O, his A-B-C questionnaire, the Allport A-S, the Laird C-2, the Neymann-Kohlstedt, Thurstone Neurotic Inventory, and the four Bernreuter scores showed only one coefficient as high as .15 with P. E.'s from .04 to .08. Hertzberg (682) found the same for freshmen in a teachers college. Flemming used four forms of score from the Pressey X-O and found correlations with grades ranging from –.1 to –.3. Hendrickson and Huskey found a relationship of –.1 (girls) or .3 (boys) between achievement and extroversion among fifth-grade children. Harris (674) studied 450 Jewish students entering City College, New York, and obtained correlations of many factors with grades. With intelligence held constant, partial correlations with age, weight, height, Payne's inferiority test, Marston's introversion-extroversion scale, number of recreations reported, number of periodicals read, hours of athletics, hours of sleep, number and kinds of books read, were all less than .2. Hours of study showed a correlation of .3 with grades when intelligence was constant. Symonds and Block (735) have published a questionnaire to help locate personal and social maladjustment in grades 7-14.

Applications to home life are implicit in Campbell's review (651) of 75 studies on personality adjustment in only children. Most of these found little evidence for the association of any type of personality with the only child. In Campbell's own work only children showed greater neuroticism and greater variability in scores on Bernreuter items, but no differences in physique or scholarship. Maller found only children rated as least cooperative, but less deceptive on cheating tests than any others except children from two-child families.

A. J. Davis (662) found a correlation of .3 between favorable answers on the Woodworth-Mathews and difference in M.A. between the child's parents. There was a correlation of .2 between "Scatter" on the Binet and the W-M score.

Harvey (678) reviewed ten studies of sex behavior and elsewhere he (677) appraised the value of questionnaires in such studies. He recommended: (a) use of a truly representative sampling; (b) follow-up letters;

(c) checks within the questionnaire itself; and (d) checks with physical examinations and personal interviews on samples of the subjects. Hurlock and Klein published a questionnaire study on "crushes" among adolescents. Childers and Hamil (660) studied case records on 469 children and concluded that there were most conduct difficulties among the 106 weaned from the breast between first and fifth month, fewest among the 137 weaned after eleven or more months. Leonard interviewed freshman college girls and their mothers on problems of college life.

An instructive method of study is the comparison of many possible factors which may differ in subjects well adjusted and those maladjusted. Cavan (659) reported that 30 percent of 9,000 adolescents have wished they had never been born. These children acknowledged many other maladjustment symptoms and were rated by teachers as maladjusted. The wish was more common among Mexican children, least so among negro urban children, but geographical and racial differences were minor. The unhappy children were more apt to be critical of both parents, to have no confidential relationship with the parents, to be punished often at home, to have no close friends. Lester and Barnette (690) compared college freshmen of the most maladjusted quartile (Thurstone test) with the best-adjusted quartile. They found the former group to be poorer in intelligence and achievement tests and slightly better in grades, with more business rather than professional fathers; to contain more Jews, more oldest children, but fewer only children; to be more introverted, less able to concentrate, more severely disciplined at home, and more apt to report their childhood as unhappy. Wang (744) compared the top and bottom 20 percent on each of five tests, using also other factors of personal history. Ascendant students reported reading more omnivorously for pleasure, being more admired by associates, participating more in games, liking foreign languages less. Introverted (as contrasted with extroverted by the Freyd test) had fewer playmates, needed urging to get into games, had practically no friends of opposite sex, went to shows alone. Stagner found introverts not reliably different from extroverts on any of ten speed measures (Downey W-T type) or on height-weight ratio.

The Bernreuter test was given by Carter (655) to 133 pairs of twins. Correlations of age (12-19) and I. Q. (73-140) with the four Bernreuter scores were all negligible. Correlations between monozygotic (40) pairs were .63 on the neurotic inventory, .44 on self-sufficiency, .50 on introversion, and .71 on the dominance scale. Correlation among fraternal-like sex twins (43 pairs) were for the same four items: .32, –.14, .40, and .34. For 35 pairs of twins of opposite sex, the correlations were .18, .12, .18, and .18. The reviewer rates this evidence for the inherited basis of self-report of maladjustment as probably the most valuable contribution in this field.

Reusser (716) applied Sweet's Personal Attitude Test for Younger Boys to 423 delinquents and a control group in the public school. The delinquents were more critical of the average boy, showed more feeling of being different from other boys, less insight in telling how other boys feel, and a greater tendency to regard their own responses as ideal.

Mathews (702) constructed a questionnaire called a "Home Blank" which was given to 568 children. Each question of fact was answered "Yes" or "No" giving a "Condition Score," and also reacted to by "Glad" or "Sorry," giving an attitude score. A "socially approved" score for condition and another for attitude was worked out by noting the extent to which the child's attitudes were in agreement with what adult judges believed would be generally approved. The children whose mothers worked out had a socially approved condition score of 72, while those of non-working mothers averaged 78. On socially approved attitude the scores were 84 and 86, respectively. Happiness scores for children of mothers who worked averaged 84, for the non-working, 88.

Jersild and his associates (685) questioned 400 children, 25 boys and 25 girls at each age level from five through twelve, regarding fears, dreams, daydreams, likes, dislikes, most unpleasant memories, happiest memories, ambitions, wishes, and preferences. Repetition of the interview after five to eight weeks gave 65 percent overlap in the content. The study showed the relation of each type of affective response to age, sex, social status, and I.Q.

Other comparisons and correlations show: sex differences (Weinberg, Stagner); age differences (Stagner); women campus leaders more extroverted and with stronger inferiority feelings (Sward); Roman Catholic priests in training as unusually introverted and troubled with inferiority (Sward); and the attitudes and maladjustments of Jewish students (Maller). Maller and Lundeen (699) found a correlation of .55 between emotional maladjustment and acceptance of superstitions, within a population of 300 seventh-grade children. Carroll (654) found no correlation between art tests and temperament tests (Bernreuter, Bathurst) as high as .2. The deaf and hard of hearing seem definitely more neurotic, introverted, and submissive (Pintner, Welles, Lyon). Pressey found Indian children to have emotional attitude scores like those of white children about two years younger. Sunner found negro students at Harvard University much like the college white groups previously given a psychoneurotic inventory by House. Brotmarkle found no relationship between the Bernreuter scores and scholastic aptitude, mental ability, judgment, verbal discrimination, common sense, general information, learning ability, motor coordination, or moral vocabulary tests. Apparently the Bernreuter is also unrelated to the Kent-Rosanoff word-association test (Laslett). Intercorrelations are reported low by others (Pintner, Stagner, Flemming), except in cases in which the tests contain many identical elements.

Many of the investigations reported seem to confirm what anyone familiar with the psychology of personality would have expected. It is possible, however, to show that competent persons may not anticipate correctly the outcome of questionnaire studies.

Watson and Green (747) showed that graduate students of education agreed with recent investigations showing: men more apt than women to be happy in marriage, preference for parent of opposite sex, more dissatisfaction with marriage in the more highly educated partner, persons with siblings of opposite sex better prepared for success in marriage, etc. In general these educators were misinformed or in disagreement with findings on the wide age range for beginning menstruation, the importance for the wife's happiness of sex adequacy in the husband, the decreasing satisfaction with marriage after the first five years, the prevalence of serious lack of self-confidence, etc. Men were no better informed than women, married persons did not differ significantly from single persons in their accuracy of estimate, and age (twenty to fifty) was not a significant variable in most judgments.

Traits Tested by Behavior

British psychologists introduced the concept of perseveration and have been active in developing and applying tests. Stephenson (731) used in a psychotic population the w-w-w test, the z-z-z test, the e-e-e test, the grouped-strokes test, and the saying-color test. Each involves ability to shift from a simple practiced series to another enough like the practiced series to cause serious confusion. The average intercorrelation of the five tests, each taking less than five minutes, was .40. Correlation with intelligence (g) was –.26. Melancholia was characterized by high "p" and high "g," dementia praecox by high "p" and low "g." Manics and paranoid cases showed low "p" scores. In a retest after several months no "p" scores deviated by more than 2 points on a 20-point scale. Pinard (711, 712) used the inverted S test, the triangle test, the mirror image test, and an alphabet test with 300 socially or mentally handicapped children. Intercorrelations were between .3 and .4. Tetrad analysis showed a group factor present in all the tests. "P" score increased with age. Of 49 melancholia cases, 37 were above the general median in perseveration; of 8 manics, 7 were below the general median. Eight of 10 obsession cases were above the median in perseveration; 27 of 34 hysterics were below the median. Twenty-four of 30 delusional cases were in the middle quartile. Trait ratings showed no such clear correlations with "p." Persons (children or adults) rated as difficult and unreliable fell (75 percent) in the extreme quartiles of perseverance or nonperseverance. Persons rated as self-controlled and persistent fell (75 percent) in the central quartiles of the perseverance scale. Rogers (719) found correlations of .3 between perseverance and marks in reading, writing, and spelling; lower correlations with other subjects. Rangachar (715) used seven tests of perseveration to compare 38 Jewish and 35 English boys. The "p" scores of the Jewish group were higher in every comparison, but the differences were seldom statistically significant. Cattell (656) tried out eleven tests of perseveration, the more reliable of which had intercorrelations averaging .2. Correlations with factors of cleverness, will, maturity, and adjustment, derived from ratings, were likewise negligible. Eight further tests including speed, reading comprehension, oscillation of ambiguous perspective, intelligence, and the psychogalvanic reflex showed no significant correlation with any of the other measures except for one result of .61 between speed of reading and the "c" factor (surgency). The concepts are elusive, the tests fragmentary, the results trivial.

Howells (683) studied persistence (not perseveration) with tests of ability to stand fatigue from holding a dynamometer, pain from pricking, heat from a grill, electric shock, pinching, and a blunt peg forced into the flesh. High scores on these tests tended to accompany willingness to endure pain for higher grades, volitional perseveration (Downey), ascendance (Allport), religious radicalism, masculinity, being the oldest child, leptosome build, and high academic grades. Wang's scale (743) for measuring persistence involves self-report on 101 direct questions. It correlates .5 with adjustment on the Thurstone scale.

"Suggestibility" is a name given to many psychologically distinct behaviors. L. W. Davis and Husband (663) studied the degree of trance which a subject developed under a standard hypnotic procedure, and found this unrelated to scores for Colgate introversion, fair-mindedness, and Pressey X-O affectivity. More intelligent and better adjusted men were more susceptible, but this relationship did not hold with women subjects. White (750) used ink-blots with and without suggested resemblances. Correlations among nursery-school children between suggestibility and I.Q. were –.40. Stevick (733) applied the progressive weight series as a test of suggestibility to 200 adults. Sixty-two percent showed no suggestibility and only 20 percent continued to imagine the increase for more than one step beyond the point where it ceased. Correlation of religious conformity and suggestibility was –.9. Bonte compared suggestibility of children when asked questions about a picture they had seen and about a staged altercation in the classroom. Eidetics were influenced in 36 percent of their answers about the picture, and in 93 percent of their answers about the incident. For non-eidetics the corresponding percents were 35 and 88. Platonov (713) suggested to three adults in hypnosis that they would awake and be only four, six, or ten years of age. They were then given Binet tests. The results show an extraordinary correspondence, the obtained M. A. being within one year of the suggested "regression age" in eight of the nine comparisons. Sherman and Crider described a case of hysteria in which a regressed patient wrote her name, drew pictures, and solved intelligence problems on the younger age level.

Williams (753) used Hull's test of forward or backward swaying in response to suggestion, and reputed catatonic and paranoid types of dementia praecox patients giving a negative response, the manics not responding at all.

The Wells Emotional Age Scale was revised by Weber and now contains problems of eight types: moral association, fear association, interest preference, interest association, collecting preference, blended emotions, matching proverbs, expressing feeling, and emotional analogies. Retest reliability of each type, ranged from .33 to .75, for the whole test .78. Correlations with intelligence ranged from .27 to .78, for the whole test .80. Correlations with C. A. ranged from .20 to .61 with .71 for the whole test. Apparently the instrument is a sort of intelligence test. Correlation with ratings on emotional age was only .3.

Willoughby (755) worked out a scale with sixty short descriptions among which the rater chooses the appropriate one. Each has been judged to have a certain value on a scale of emotional maturity.

Physiological and Laboratory Tests

The most ingenious and promising advance in technic during the period under review was reported by Lasswell (689). He conducted portions of psychoanalyses, under conditions which permitted a record of everything said, of the patient's bodily movements, his pulse rate, and the electrical conductivity of the skin. Reflection on the probable correlations suggested that when the patient was speaking directly about the analyst, he would experience more effect and the pulse rate would probably increase. During periods of tension skin conductivity would increase but rate of speaking would decrease, and the reverse would be true during absence of tension. Formal check was made by studying pairs of days in which the second varied significantly along one of these lines, from the day preceding. Thus on 20 pairs of days showing increased pulse rate the second day, there was an average of nine more references to the analyst during the second interview. For the reverse pairs, with decreased pulse rate the next day, the references to the analyst decreased on the average by eleven. Similar confirmation of the other hypothesis was possible. This is clearly only a beginning of the interesting interpretations which may be expected from the abundant data.

Dysinger and Ruckmick (665) also used verbal, psychogalvanic, and pulse records in their study of the influence of moving pictures on 150 children and adults. Average P G R deflection for scenes of danger and conflict was 2.1 mm. for children, 1.8 mm. for adolescents, and 0.9 mm. for adults. For erotic scenes the deflections averaged 0.8 mm. at age nine, 1.0 mm. at age sixteen, and 0.3 mm. for adults. Repetition of the picture decreased the effect.

Nomura used time of delay in a learned reaction and number of errors in the reaction, as a measure of surprise-effect. Rowland suggested events, graded in their affective character, to hypnotized subjects, and showed a fair correlation between the judgment of emotional excitement and increased irregularity in a breathing curve. Luria's book (695) is an outstanding contribution, perhaps the most stimulating combination of theory and practice in this review. He conceives of a "functional barrier" which keeps conflict in the higher cerebral centers until a course of action is found in which the whole organism can be integrated. Premature emergence of the conflict into the muscular system creates disorganized behavior. The functional barrier is weak in early childhood and in fatigue. Strong emotion may cause a short cut or overflow into the motor system giving impulsive or diffuse reactions. Luria developed and tested his theories in experiments involving word association, record of accompanying voluntary and involuntary movements, breathing curves, creation of artificial conflicts by hypnotic suggestion, tests requiring quick shift from one language to another, rhythmical motor reactions, tests involving choice among arbitrary alternatives and alternatives with associated cues, tests which seemed easy but quickly became impossibily difficult, voluntary motor action in cases with certain nervous disorders, drawings, and other symbolic surrogates. Unfortunately the book is poorly translated and so badly arranged that many readers give up before getting to the last few chapters which are the most important. Olson and Jones (707) followed up Luria's idea of disorganization of behavior in conflict situations. They proposed emotionally toned words and propositions (also control stimuli) to subjects for rapid associative reaction. A voice key indicated the time taken to respond, and simultaneously the subjects were supposed to press down keys with each hand. The emotionally toned material produced significantly more vigorous responses. Correlations with self-rankings were about .5; those with rankings by friends about .1.

Hersey (679) observed twelve workers for some 300 two-hour periods and estimated their emotional states. In positive moods (elated, happy, hopeful, cooperative, pleasant), production, objectively measured, averaged 102; during neutral moods (indifferent, excited, tense, mixed) 100; during negative moods (unpleasant, suspicious, peevish, angry, disgusted, sad, pessimistic, worried) production averaged 93. Averages were consistent in the case of each man. Hartenstein used introspective reports of mood for eight subjects given laboratory tests on different days. There was no convincing evidence of the effect of weather on efficiency, and the effect of mood varied with the individual.

Treatment

Rarely are tests reported as part of a total experimental process: test-treat-test. When more studies of this type develop, there will probably be more enthusiasm on the part of educators for personality measurement. McLaughlin (696) used the Allport Ascendancy-Submission Scale and ratings by associates with 400 college students, identified extreme cases, and then carried on a re-education through interviews, help from friends, selected readings, reports of analagous cases, correction of speech and other handicaps, and readjustment of environment. The test was not repeated after the training, but another set of ratings was secured from the same judges. Among 12 markedly ascendant students, only 5 appeared to have changed in the desired direction. Among 13 extremely submissive subjects, 12 showed improvement, 4 marked improvement. Laird and others (688) selected 53 children who seemed, on the Olson Behavior Check List, to be unusually nervous. Diets directed toward building up calcium metabolism brought about demonstrable improvement over control, particularly in the group taking milk and a food concentrate at the middle of the morning. Fajans (667), in one of Lewin's impressive and valuable investigations, showed how ambition and perseverance could be built up. Experiments demonstrated a series in which the most powerful was success in an assigned task which appeared difficult, said success accompanied by encouragement. Success alone had more effect on future behavior than did praise alone.

Tests Related to Unconscious Reactions

Tendler (736) gave the Kent-Rosanoff Word Association Test to 50 psychoneurotics and made an unusually careful analysis of the types of response. Frequency score correlated with some of the types of association as follows: contrast, .67; similarity, .50; noun-adjective or adjective-noun, –.80. Individuality of response correlated –.3 with contrast, –.5 with similarity, .60 with adjective-noun or noun-adjective score. He proposed that association by contrast, superordination, and coordination be regarded as adult types; association by contiguity, adjective-noun, or noun-adjective as juvenile. In the Rosanoff frequency tables were 44 of the former and 16 of the latter. In the Woodrow-Lowell norms for children there were 11 of the adult type and 44 of the juvenile. McElwee found subnormal adolescents giving many more reactions of zero frequency than were given by normal children or adolescents. Copeland studied frequency of usage for 15 words and found unfamiliarity to correlate (rho) with reaction time .7, failure to respond .9, with psychogalvanic reflex, zero. Fisher and Marrow suggested post-hypnotic moods of elation and depression, with a result that word associations were slowest in the depressed mood and fastest in a normal state. This was true whether stimuli were supposed to be pleasant, unpleasant, or neutral.

The Schwartz social situation pictures are drawings of children in situations in which delinquency seems imminent (724). They are supposed to be used in supplementing other forms of examination to get beneath the surface with delinquent boys.

The Rorschach Test was used in more than a score of studies published during the past two or three years. Hertz's recent review (681) of Rorschach literature contains 152 items. The popularity of this test arises in part from the fact that it is almost unique in approaching personality as a whole rather than atomistically. A two-volume edition (721) of Rorschach's original study, supplemented by two other articles, appeared in 1932. English descriptions of the test have been written by Beck (640) and Vernon (740). Variations of the original blots have been used by Behn-Eschenberg, Roemer, and Gordon and Norman. Loosli-Usteri and Vernon have published suggested improvements in technic of administration. Hertz

(681) summarized reports of reliability, found most of them low, and proposed a standard procedure which raised most of the measures above .6. Norms are inadequate and there has been some controversy about the necessity for age norms. Loosli-Usteri (693) found few movement responses among children nine to fourteen. Bleuler (648) found siblings more alike than are unrelated subjects, and Verschuer (741) found monozygotic twins more alike in Rorschach measures than are fraternal twins. Vernon (740) found some correlation with artistic aptitude. Hertz (680) found color response highly correlated with ascendancy and movement responses with submission. Color response was similarly indicative, in her studies, of Woodworth-Mathews symptom score. Wertham and Bleuler (748) used the test before and after taking the drug mescaline, with resulting evidences for change in personality. Levy and Beck (691) tested patients during a manic attack and after recovery. Recovery was indicated by increase in number of replies, decrease in color responses, decrease in originals, and increase in responses determined by form. Oberholzer used the test to aid in differential diagnosis of skull injuries. Meltzer (703) reported results on stutterers. Beck (640) found mental age among the feebleminded, correlated with excellence of form perception .6, and with tendency to interpret the picture as a whole, .5. Hertz's results (680) were in agreement: .5 for superior form answers; but he disagreed on the significance of wholes and added a significant correlation (.4) with original answers and a negative relation (–.4) with oligophrenic details. Beck (641) in another study found agreement between the Rorschach analysis and clinical studies in 33 out of 37 cases.

Wolff (757) recorded the voice, hands, profile, and free recall of a story, for each of his subjects. Later each subject was asked to identify others' and his own. He discovered that errors were in the direction of approach toward the subject's ideal of himself as he would like to be.

Typology

With the increasing trend toward organismic thinking and the consequent necessity to try to study the personality in its unitary, integrated form rather than in elements like traits, there has come increasing attention to characterology and typology.

The best verified typological difference is that which takes extreme form in the commonly accepted categories of psychosis. The schizophrenic differs from the cyclic manic-depressive, and a smiliar difference can be observed within the normal population between schizothymes or schizoids, and cyclothymes or cycloids. Bowman and Raymond (649), Bigelow (646), and Faver (668) have described the pre-psychotic schizoid as seclusive, irritable, oversensitive, anal-erotic, narcisstic, feeling insufficient, etc. Smalldon (726) described the cycloid as pyknic, voluble, hyperactive, extroverted. Eyrich (666) found less similarity among epileptics, but proposed three typical syndromes which the Rorschach test helped to identify: (a) retardation, impoverishment, inelasticity of mental life; (b) vain and egocentric oversensitiveness and irritability; and (c) restless activity, distractibility, tension, but absence of feeling. Willemse (752) used case studies, letters, laboratory performance, Rorschach tests, drawings, physical measures, etc., in studying adolescent delinquent boys. He agreed with Kretschmer's thesis that the boys with leptosomic build lacked energy, were timid, easily influenced, solitary, self-conscious, with silent scheming and sexual maladjustment. The pyknics might be sociable optimists, or querulous cholerics, or undaunted adventurers. Humm and Wadsworth (684) standardized a scale for normal, hysteroid, cycloid, schizoid, and epileptoid components in temperament. Burkersrode and Ille (650) used self-ratings, ratings of others, tests of attention type, flexibility, form and color influence, etc., in confirming the Kretschmer typology. Watson (746) reviewed German psychology and summarized results from about 8,000 cases, in which 50 percent of the schizophrenics were leptosomes, while 65 percent of the cyclics were pyknics. Revesz (717) listed eleven types largely derived from psychopathology.

Pavlow and his followers have distinguished four types: inhibited, excitable, labile, and inert. Khozak (686) added a few intermediate types as a result of three conditioning experiments with each of fourteen children.

Two recent books can be added to those giving fairly comprehensive reviews of typology, one in German by Rohracher (720) and one in Rumanian by Todoranu (737). The latter emphasizes activity, emotivity, and psychic force or intensity as the central variables in temperament. His tests lead him to believe that two major types in accord with Kretschmer's thesis can be identified. Heymans and Wiersma were among the first to collect extensive ratings on character. Wiersma (751) recently published the distinguishing characteristics of some 80 persons (among their 2,500) who were described as persistent liars. They were rated as emotional rather than non-emotional, inactive rather than active, and dominated by primary function, i.e., absence of perseveration. This combination makes the "nervous" type. Only one was described as continually industrious; the liars were usually said to be lazy, violent, fond of variety, repeatedly changing their occupation, and very vain.

Beck (638, 639) from his experience with the Rorschach test has tried to build a typology around four variables: form perception, organizing energy, affective drive, and creative ability. The interaction of these with the particular environment determines the personality.

Psychoses

Development of a psychosis is an extreme giving indisputable evidence of personality maladjustment. Reference has been made in several of the preceding studies to the use of psychotic groups in the validation of instruments.

Mason (701) used commitment to a mental hospital as an index of emotional adjustment among teachers, and studied 700 such cases. As compared with the classifications from the general population, the teachers showed fewer cases of general paralysis, alcoholism, and epilepsy, but more cyclic and paranoid psychoses. In heredity likewise these teachers showed a large proportion of functional disorders. Among the teachers 77 percent were single, while in the general population of the state hospitals only about half that many are single. Economic conditions of the teachers were superior to those of the unselected cases. Contributing causes present in 10 percent or more of the cases included: venereal disease, worry over the possibility of venereal disease, sex conflicts, excessive masturbation, poor health, and school troubles. Only 4 percent of the men reported interests in sport, dancing, theater, music, or travel. Reading, study, and religion were the common interests. About 60 percent of the cases were regarded by friends as sensitive, shy, and seclusive. Two-thirds were graduates of normal schools or colleges.

Comment

The chaos of theory in relation to emotional growth, neuroses, psychoses, and psychotherapy seems to have resulted in many deplorable superficial investigations. It seems easy to buy a printed blank, count the answers, and compare one group with another. This type of study avoids coming to grips with any of the genuine issues. The most urgent need in this area of study, is the development and use of measures by persons who are experienced in the clinic, who are thoroughly conversant with the doctrines of the neurologists, of Freud, Adler, Jung, and their successors, and who are at work on some of the basic problems. Sound measurement technics cannot develop faster than clear thinking and crucial experiments concerning the nature of the phenomena to be measured.

CHAPTER VII

Social Attitudes

Social Behavior

WHILE psychologists were carrying on the studies of social attitudes reported in this chapter, our national income tumbled to half its former size and unemployment rose to include at least one-fourth of the workers of the country. Political leaders together with many writers of editorials and magazine articles expressed a conviction that basic changes were taking place in the attitudes of the American people. The most interesting fact in this review of research is that a reader going through the more than two hundred scientific studies would find very few attempts to describe or to interpret any aspect of this social situation.

Due to limitations of space studies deemed less important (about half as many as those here mentioned) have been omitted entirely.

One study, Almond and Lasswell's comparison (760) of docile versus aggressive personalities among the recipients of relief, did bear directly on the present scene and the forces at work creating attitudes. There has been much speculation as to the class or group which will furnish the drive toward a new society. Lasswell compared 100 aggressive clients and 100 submissive clients, and found the aggressive to have had a year longer on the relief rolls, to have held more political jobs in the past, and to have had more arrests for various offenses. Among the aggressive he also found a larger proportion who married outside their national and religious group, a larger proportion whose occupations dealt primarily with persons rather than things, a larger proportion from dangerous occupations, more shifts in occupations, more trade union members, more education, larger incomes, and the payment of higher rentals. The aggressive averaged nearly ten years younger, were more largely a native-born group from the surrounding region, were much more predominantly urban, were less likely to own their own homes or any other real property, and were slightly more apt to show physical or neurotic handicaps.

Baker (766) studied race attitudes using primary historical sources (newspaper clippings, magazine articles, files of correspondence of organizations concerned, interviews with participants, visits to the scene of action, etc.) and concerned himself particularly with the relative effectiveness of ten organizations which have been active in attempting to attain justice and equality for the negro race. An incidental portion of his study included questionnaire responses from 200 people who had changed their attitude. The opinions pointed to personal contacts with negroes, and participation in interracial projects as major influences. Baker identified two broad types of goal (bi-racial versus amalgamation) and two broad types of method (conference versus force). The immediate trend appears to be an increasing use of force by groups working toward both types of goal.

Lasswell and Baker were almost unique among those reviewed in this chapter in deriving their measures of attitude from overt behavior rather than from verbal expressions on a questionnaire or scale. Kelley and Krey (812) in their volume of investigation under the auspices of the Commission on the Social Studies of the American Historical Association attempted with Thurstone's help to construct an attitude test for junior high-school children. They listed six basic difficulties which led them to give up their attempt to use such scales, and which apply in some degree to nearly all of the studies dealt with in this chapter:

1. Administrators were afraid to permit the use of tests which even suggested markedly unconventional positions.
2. Pupils did not understand the terms and concepts. It was impossible to know from their checked response what they had really understood by the proposition.
3. Attitudes vary in depth, stability, and permanence, and the scale responses give no clue as to these differences.
4. Most people are reluctant to tell what they think about important issues except under rare conditions of exceptional confidence. "Only the most rabid partisans are willing to divulge their attitudes freely, and for such no test is necessary." Children in school are apt to protect themselves by answering what they think is expected; adults by refusing to answer the questionnaires.
5. There is sometimes a tendency toward compensation. The person lax in conduct may try, consciously or unconsciously, to make up for this by extreme verbal condemnation of such behavior.
6. Many of the answers were superficial snap-judgments, given rather to oblige the questioner than because of any independent attitude on the part of the subject tested.

Kelley and Krey reviewed various methods for ascertaining attitudes and concluded: "The new-type test is most direct and perhaps, therefore, least efficient." The historian's comparison of words and acts they would rate first, but would put essays, interpreted by the teacher, ahead of scales and blanks. The Commission as a whole concluded in their summary volume (761) that results must be tested "not in the classroom by teachers, but in the arena of social and political life and by the long sweep of history." In another chapter, written for but not included in the report, Horn and Lindquist (802) recognized many limitations, but concluded that if attitude scales were used for description rather than for the evaluation of attitudes, and were used only in situations in which the testee had no incentive to conceal his true attitude, that they offered excellent possibilities. These authors observed that progress in scale construction could not go far without better definition of educational objectives in terms of general emotionalized attitudes, and more authoritative description of the specific situations in which attitudes should find expression. Other reviews, less critical and more in the nature of summaries, have been made by Sherman (845), Droba (785), and Fujibayashi.

Changing Attitudes

Especially in a society which suffers from the lag of social attitudes behind mechanical progress, it is important to investigate how attitudes can be changed. Cherrington (779) gave the Heber Harper Test of International Attitudes to nine groups before and after various types of study program. All except one (adult women, average age 50, widely travelled, from well-to-do homes, meeting weekly) showed movement toward a more international outlook. College classes in international relations showed considerable gains, but a seminar of advanced students working at Geneva, Switzerland, under some of the world's most eminent instructors showed little "gain" in test score. Undoubtedly they gained much from the experience, but sudden immersion in the intricacies of international questions shattered some of the liberal attitudes they had brought with them, and left the students more hesitant about expressing any judgment. Eight other groups were tested for attitudes toward war and disarmament before and after periods of lecture, seminar, institute, etc. Little change was found in groups which had gone through many hours of lecture, study, and discussion, but very marked changes were found in two groups subjected to brief but powerful appeals. One of these latter heard Kirby Page give an address condemning war; the other read the Eddy-Page pamphlet *The Abolition of War.* After twenty-four hours the group who heard the speech showed a shift 10 times its P. E., and those who read the pamphlet a shift 7 times its P. E. Retest after six months showed that the change had shrunk to about half its former size, but was still significantly (4 or 5 P. E.) different from the initial score. After some months of preparation, a group of representatives from several colleges met in a model disarmament conference, preceding the actual world conference. Students were assigned to represent as faithfully as possible the attitudes of some participant country. Commissions like those on the draft convention were set up. Professors were on hand to act as consultants, but there was much emphasis on student initiative. The conference met for two days in the state capitol building at Denver. Participants, 116 in number, were listed before and after the conference, using the Thurstone Attitute toward War Test and a new test, devised by Cherrington, using the Thurstone technic, on Attitude toward Disarmament. Differences were only about twice their P. E. and did not vary significantly from a control group, similar in age, sex, and college year, but who had no connection with the model disarmament conference.

Biddle (769) tested the ability of students to recognize typical propaganda tricks and found that a course of ten lessons which was prepared to expose these methods produced significant gain in ability to recognize and to discount them, even in changed content. He reported a correlation of –.36 between knowledge about international relations and susceptibility to articles appealing to prejudice. Peterson and Thurstone (833) showed that motion pictures influenced attitudes (as checked on a printed scale) toward race, nationality, crime, war, punishment, and prohibition. The changes persisted over months. De Feo (780) found that the commercially exhibited war pictures shown to 15,000 Italian children had the effect of glorifying war, and instilling a sense of patriotic duty to fight for one's country. Shuttleworth and May (847) verified the hypothesis that moviegoing children valued clothes as an aid to popularity more than did children who attended infrequently. Most of the obtained differences were explained by these investigators as due to selection of group rather than influence of the movies. Vincent (861) found about half of 200 adults convinced that the theater had influenced their attitudes toward social problems. Robinson (839) tested 400 adults before and after radio talks on unemployment. As compared with a control group, the radio audience had more suggestions for decreasing unemployment (particularly via unemployment insurance), and showed a decrease in the proportion of statements rated as doubtful. Chên (778) tried out brief speeches (pro-Japanese, pro-Chinese, or neutral-factual) on Manchuria and on Oriental art. He found each type of material effective with persons originally at any position on the scale. Marple (824) obtained further data on the comparative influence of majority opinion and expert opinion, finding, as did previous investigators, that knowledge of what one's group thinks or knowledge of what authorities answer, brings about marked tendency to agree with such influences. In this case group opinion seemed somewhat more effective than the opinion of the experts. Marple added the factor of age, finding the greatest susceptibility among 300 high-school seniors, a middle position for 300 college seniors, and least susceptibility among 300 adults averaging 40 years of age. Kulp (817) found students of education more responsive to the prestige influence of liberal educational authorities than to the similarly offered answers of liberal laymen or liberal experts in the social sciences. A retest eight weeks later, using simply the Harper questions and no report of answers by experts, showed that the prestige influence was still effective on 90 percent of the changed items. Kroll (816) applied the Harper test to six twelfth-grade classes in February and again in June to compare the influence of conservative and liberal teachers. Of the three conservative teachers one had an influence clearly in the liberal direction, another probably slightly in this direction, and the third teacher's class showed no change in attitude. The three liberal teachers all exercised very strong influence in the liberal direction. (Probably some of the apparently "liberal" change should have been attributed to the content of the course of study.) There is apparently a tendency for college students to shift toward liberalism on the Harper test in the transition from the freshman to the graduate year. Boldt and Stroud (772) also found that liberalism tended to be associated with the number of hours of work taken in the social sciences. The data were interpreted to show the influence for college attendance and types of courses. Annis and Kirkpatrick found "planted" content in college papers influential. Campbell, Droba, Salner, and others reported that students are influenced in a liberal direction by liberal courses in college.

Jack (808) used an interview technic before and after a four-month course in parent education. Differences on the whole were slight, but as might have been expected, those who were most backward at the beginning made larger gains.

Correlates of Social Attitudes

Another type of study, less direct and convincing, is based upon the correlation of differences in attitude with other observed differences. Thus Kulp and Davidson (818) found siblings alike in attitudes on international relations to the extent indicated by a correlation of about .3. Wrightstone (870) constructed a test of liberalism on race and international and politico-national questions, which was administered to about 400 pupils. Liberalism was correlated with historical knowledge (.58), number of periodicals read (.37), socio-economic status (.28), number of courses in the social studies (.19), verbal intelligence (.11), emotional stability (.08), and masculinity. Harris, Remmers, and Ellison (798) used Harper's Social Study Test with about 300 students at Purdue. Liberalism, in their findings, was correlated with intelligence (.29 for men, .09 for women), with self-estimates of liberalism (.3 to .4), with never going to church (–.65), with absence of religious preference, belief in evolution, independent political affiliation, with the study of sociology, and with masculinity. Whittaker (866) constructed tests of opinion about government and capital and labor for 600 high-school pupils. Rural groups, compared with town and city pupils, seemed most strongly devoted to the present government, also to favor labor rather than capital.

Carlson (775) found a correlation of only .21 between scores for information and self-rating on the certainty with which opinions about presidential candidates (1928) were held. Intelligence had zero correlation with general certainty, but a correlation of .28 with information. Men were much better informed and slightly more certain than women. Graduate students were least inclined to assert positive certainty; freshmen were most poorly informed.

Velecika (859) found no correlation between social attitudes of children expressed in a questionnaire, and observations of their social behavior. These social attitudes were likewise unrelated to intelligence.

Heber Harper's extensive questionnaire on international relations presenting 352 questions on twelve themes, is outstanding because of the scholarship behind the statements. Few attitude tests have been prepared or criticized by persons of superior competence in the subjectmatter concerned. Harper (797) compared results from 1,700 students in eighteen universities in eight countries. International organization was most popular among the students in France and England, least trusted by those of Austria. Nationalism was no more prevalent in Germany than in the United States. Psychology students were less likely than were students in other fields to believe war a necessary institution. Kolstad (814) examined in more detail 500 Harper blanks filled out by American students and found liberal international attitudes correlated with: intelligence (.19); masculinity; a major in history or educational administration rather than one in nursing, physical education, or household arts; more advanced degrees; graduation before 1918; travel abroad; independent political affiliation; residence in the West North Central region rather than in the South Atlantic; and affiliation with Congregationalists rather than Lutherans. Droba presented his study of militarist-pacifist attitudes in several articles in addition to the one included in the bibliography (784). He found pacifist attitudes among students at the University of Chicago correlated with: age, femininity, social-science study, independent or socialist political affiliation, liberal Protestantism rather than Lutheranism or Roman Catholicism, absence of military service, foreign parentage, and academic scholarship. No relation was found between response to his scale and intelligence, education of parents, occupation of father, or nervous symptoms, as reported on a questionnaire.

Race attitudes were studied by Guilford (795) using paired comparison of 15 "racial" (really primarily national) groups, in seven universities. Students at New York University differed distinctly from those in other schools. The nationality of the students' parents was related to favor for that group. Zeligs and Hendrickson (872) used a type of Bogardus social-distance scale to study the attitudes of 200 sixth-grade children toward 39 "races" (again, nationalities). Correlations between attitudes of boys and girls, Jewish and non-Jewish, were .85 or above. Acquaintanceship made for tolerance in all cases except the negro. Garrison and Burch (791) used 35 true-false statements on negro-white relations, chosen from the questionnaire prepared by the Social Science Research Council Committee. Less than half of the students at North Carolina State College accepted such a statement as, "The principles of brotherhood should hold in relationships with negroes." Freshmen were more intolerant than seniors, and students from rural communitiese more intolerant than those from urban centers. Reckless and Bringen (836) used 40 statements from C. S. Johnson's questionnaire on racial opinions to compare with results on 40 information items. Correlations between information and attitude favorable to the negro were .88 in the South, .58 in the North and West. Minard (827) found race attitudes fairly well defined by seventh grade, and always far below what experts deemed desirable. Intelligence was conducive to better race attitudes, but these attitudes showed little relation to sex or to socio-economic level within Iowa towns.

An unhappily large number of studies not reported here dealt simply with the attitudes of some college class on a set of opinion statements, or compared results among various college classes. In general, college training appears to have some liberalizing effect, although the proportion preferring Fascism to Bolshevism in Willoughby's study (867) of Stanford University students rose from 60 percent of the freshmen to 75 percent of the seniors. Moore and Garrison (829) pointed out that A students made 53 percent of the possible radical choices and none of the reactionary sort, while D students made only 4 percent of the possible radical choices and 13 percent of the reactionary ones. Conservatives and reactionaries were relatively more frequent in North Carolina State College, less so in Washington State College, and least in evidence at New York University. Stalnaker (850) made a Thurstone scale on attitudes toward athletics and reported athletes most favorable, college administrators least so.

While no studies dealt directly with the attitudes of owning classes versus working classes, Arnett (764), in addition to reporting the general conservatism of 1,076 schoolboard members taking the Manly Harper Social Belief and Attitude Test, analyzed results by vocational and other categories. The most conservative were those in clerical, proprietorial, and managerial occupations; the most liberal were the professional workers. Age seemed to make relatively little difference except that those from sixty-one to sixty-five years of age were markedly more liberal than those younger or older. Liberalism increased generally for those with more than thirteen years of schooling. Independents in politics, were, of course, more liberal than Democrats, and much more liberal than Republicans. Sex differences, sectional differences, and differences due to size of community were slight, except that those from cities over 50,000 appeared more liberal. Uhrbrock (857) constructed (Thurstone technic) a scale of attitudes toward the company, and administered it to 4,430 employees under conditions assuring them that their frank and anonymous opinion was desired. Most favorable were the foremen, 86 percent of whom exceeded the mean of the factory workers. Next came the office clerks, 77 percent of whom were better satisfied than was the average factory hand. Correlation between attitude toward the company and information about the company was —.01; correlation of attitude with intelligence was —.14.

Grauer (794) tested job satisfaction, mechanical performance, and rate among sewing-machine operators. Attitudes toward the tests were rated by examiners. Earnings correlated .67 with the performance tests, .42 with favorable attitudes toward the tests, and .33 with job satisfaction. Hall (796) gave a questionnaire designed to give measures of occupational morale, attitude toward employers, and attitude toward religion, to 360 unemployed and 300 employed engineers. Employed men were more ambitious and favorable in their attitudes toward engineering as a profession, and were also more appreciative of employers. Favor toward employers among the employed men increased with age. Bitterness toward both job and employer increased with increasing period of unemployment and with financial desperation of the unemployed men. There were clear differences between the employed engineers who felt secure in their jobs and those who feared a lay-off, the latter approximating the attitude of the unemployed. Kornhauser and Sharp (815) used questionnaires and interviews to obtain attitudes regarding work from 200 factory girls. Two departments, identical except for having different forewomen, showed in one case 71 percent of the girls favorable toward their job, in the other case only 29 percent. Sixteen of the 25 most neurotic were dissatisfied; only 3 of the best adjusted emotionally were similarly dissatisfied. Equal pay for all was favored by 75 percent of those with low efficiency records and by 36 percent of those with high efficiency records.

Interesting studies have been made of differences in attitude among racial and national groups. Gardner (790) found negroes no more different from whites in association tests than two white groups were from each other. Shores (846) found correlations of .82 between the non-fiction reading interests of negro students at Fisk University and white students at the University of Chicago. Sex differences were greater than race differences. Pressey and Pressey (835) gave his test of emotional attitudes and interests to nearly 2,000 white children and an equal number of Indian children above fifth grade. By white norms, the Indians showed retardation of two to five years in emotional age. Chant and Freedman (777) reported Canadian and Chicago students alike in nationality preferences. Thomson (856) showed a picture designed to arouse sympathy, to about 50 each of German, Esthonian, and Russian young people. Subjects reacted by reporting emotions felt, by drawing lines unconsciously, by giving color reactions, by telling what action they would take, etc. The most expressive (perhaps partly due to the conduct of the experiment in the German language) were Germans, next Russians, least Esthonians. Boys were more expressive than girls. Köhler (813) reported cultural differences in his statement that attitude scales would be little used in Germany because Germans objected to being questioned about such personal matters. Madden and Hollingworth (822) found white judges and Chinese judges to use different standards in judging the beauty of white adolescents.

Lewerenz (820) gave his Questionnaire Orientation Test, which is concerned with opinions about health, education, leisure, home life, culture, etc., to juvenile delinquents, adult prisoners, policemen, and superior adults, finding the average scores to increase in the order named, with the last group much superior to the other three. Hendrickson (799) compared 87 sophomores in a teachers college with a group of experienced women teachers and found the latter to be: older, less interested in dances and other social activities, less interested in light entertainment, less inclined to physical exercise, more apt to go to concerts or to visit art galleries, and more interested in stocks and bonds.

Attitudes differ not only among racial, national, and occupational groups, but change over a period of time within any given group or section of society. Bain (765) found that the mental hygiene approach had so permeated popular thought that incoming students in 1932 agreed much more closely with Wickman's mental hygienists than did corresponding groups in 1927. Acheson found deans of women reporting considerable liberalization in their attitudes. Montelli (828) used the technic of asking, "What would you do if you had a magic cap?" to show how much more practical, concrete, and social are the interests of Russian youth today than were the sentiments expressed before the revolution. Schank (840) analyzed two changes in rural community attitudes, one in which vested interests developed sentiment for a particular site for a consolidated school, and another in which private attitudes toward baptism and card playing triumphed over the previously maintained publicly acceptable stand.

Moral Values and Religious Attitudes

Among the twenty-five studies of moral and religious attitudes, the most numerous were Dudycha's detailed reports (787) on student beliefs in religious doctrines, superstitions, social and moral problems, evolution, etc. Binnewies (770) tested religious beliefs before and after eight lectures which succeeded in bringing about a marked shift toward liberalism. Betts, Clem and Smith, Durea and Simpson used the old technic of getting names of types of offenses ranked in order of badness, with the outcome no more illuminating than has usually been the case.

Since Wickman's original study of the seriousness with which teachers as contrasted with mental hygienists rated various offenses, several others have used a similar technic: Stogdill (853) compared ratings by parents, students, and mental hygienists. Watson (863) showed that the mental hygienists did not agree among themselves any better than the teachers or parents agreed with them, that the offenses were stated too vaguely and generally to make possible any reliable rating or valid interpretation, and that the questions given to the two groups were not really comparable. He argued that such studies showed only that either group, both groups, or neither group may be right. Mathews (825) asked 500 students and 50 faculty members which of several described cheating incidents they could justify. Laxer standards appeared to prevail among students, men and upper classes. Schneckenburger (842) compared attitudes of children from proletarian homes with attitudes of children of similar age from middleclass or bourgeois background. No differences appeared in reactions to pictures of boys (a) attacking a girl or (b) sticking a sleeping grandfather with a pin; but on (c) a picture of a thug clubbing a rich man, the testimony (oral) of the proletarian children showed 28 percent approving and 15 percent excusing, while among the bourgeois children only 10 percent approved and none suggested excuses. Schmeing's questionnaire (841) on negative ideals among 1,000 school children showed the importance of studying not only what children seek, but equally what they wish to avoid, e. g., contempt of their fellows, unemployment, or illness.

A new approach to the problem of moral knowledge, and one which might well be adapted to other problems, was worked out by Yates (871). He analyzed 150 suits for slander and developed the accepted principles. On the basis of these principles he constructed a questionnaire for children, revealing the areas in which they needed instruction.

Gilliland (792) used 40 statements supposed to test superstition after a psychology course and found an average reduction from about ten errors to six errors. Whitelaw and Laslett (865) gave the Nixon list of superstition statements to their classes. Caldwell and Lundeen (773) reported extensive studies of superstition among secondary-school pupils.

The Allport-Vernon Scale of Values, based on the six types suggested by Spranger, was further tried out by Cantril and Allport (774) on 2,755 persons. Reliabilities appear satisfactory except for "social" value. Graphologists' rating for esthetic value correlated .4 with the test indication; ratings on economic value (.3), and theoretic (.25) were also indicative of some relationship, but the other lines measured showed no agreement. Pintner (834) found students majority in mental testing rating higher on esthetic, lower on political, and in the case of the men, higher on theoretical, values than were the A-V norms. Men in administration appeared low on esthetic value. Intelligence correlated .4 with social values, .2 with theoretical values, and –.4 with economic values. Class marks were similarly related positively to social values and negatively to economic values. Self-ratings varied from .68 for religious values to –.02 for political values. Attitude toward the church (Thurstone scale) correlated –.78 with religious values as measured on the Allport-Vernon Scale.

The most comprehensive analysis of religious attitudes, published during the period of this review is Woodward's attempt (869) to correlate adult religious views with childhood emotional development. Conservative religious attitudes were found among those who had grown up in religious homes, had experienced strong sense of guilt and sex shame, had not rebelled against home discipline, had experienced cooperation and companionship in the family, and had been dependent on parents. Vetter and Green (860) found members of the Association for the Advancement of Atheism typically to have grown up in a strictly religious home, to have left the church during adolescence, to have been unhappy in childhood, to have lived in cities over 25,000 population, and to attribute their atheism to wide reading and disgust with religious hypocrisy.

Donnelly (782) developed a test for high-school students to measure faith in God. Part I was a vocabulary test to make sure of adequate understanding. Part II contained twelve items concerning conduct, with opportunity to indicate how much conduct would probably be influenced by faith in God. Part III consisted of statements showing tendency to trust in God. These were scaled by 120 judges. Part IV consisted of statements of belief about God, more intellectual in form. Reliabilities were .68, .72, .48, and .83 for each of the four parts; .88 for the total test. A study of Jewish students was made by Nathan (830). About 60 percent reported impersonal concepts (including naturalism, skepticism, and agnosticism) of God, while 33 percent more nearly approached the orthodox personal concept. The proportion in these groups was unrelated to extent or type of religious instruction previously given.

Interests: General and Vocational

Katz, Allport, and Jenness (811) asked over 4,000 college students their attitudes toward study, social life, fraternities, instructors, religion, music, athletics, academic freedom, personal problems, cheating, and many other matters. The results have been published, but hardly lend themselves to summary. Sheldon (844) reported on vocational, recreational, service, and home interest activities of 1,087 boys and girls in the upper grades. Hildreth (800) studied preferences of over 200 adolescents for games, companions, school activities, reading, and vocations. Interests of Chinese youths were studied by Stowe (854), Chang (776), and Webster (864). Denisov (781) studied interests of upper-grade children in the Soviet Union and Antipoff (762) asked ten "preference" questions of 760 pupils ten to fourteen years of age in Bello Horizonte, Brazil. Drake (783) tried out an interest test and the Pressey X-O in a fruitless endeavor to improve prediction of college scholarship. Thomas (855) compared interests of public school and detention school boys, finding delinquents more likely to read Hearst newspapers, less likely to use libraries, more frequent in movie attendance, less apt to have a radio at home, but differing little in preferences as to games and active recreation. Reading interests were studied in the Soviet Union by Ivanov (807) and among 25 negro women by Hudson (803). Witty and Lehman (868) found rural children making more collections than did city children. Jones and Conrad (809) reported that country people liked action movies, especially "Westerns."

Fryer (788) has published a thorough review of interest studies, and also a suggestion (789) of five ways (control samples, selection of samples, group differences, extraneous criteria, and use) of validating interest measures. Schuwerack (843) used the device of asking young adolescents what they would do if they should suddenly become rich. Investment with a view to practical returns, provision of security for loved ones, and foreign travel were the majority types of response. Hildreth, Illge, Jones, and Wallace have published questionnaires to inventory interests.

Hurlock and Jansing (804) asked 1,132 boys and girls, age fourteen to eighteen, negro and white, concerning the vocation they would like most to follow, the one they are most likely to follow, and the vocation their parents would wish. Negro boys chose teacher, civil service, and machinist; white boys chose aviator and engineer. Negro girls chose teaching almost exclusively, while for white girls teaching rated below business. Over three-fourths of the pupils chose occupations other than those of their parents. Vampa (858) reported on the use of a questionnaire together with tests of attention and memory, as a means for constructing profiles which aided in the vocational guidance of 120 Italian boys. Lehman and Witty (819) found pupils most apt to choose the occupation they had rated as a good money-maker, next to choose the one they thought of as most respected, and least apt to choose the one they thought of as easiest. Proportions choosing by money and esteem were greatest at age twelve;

those choosing by ease were the youngest group studied (age eight). From their study of play interests, cited in the previous *Review of Educational Research,* Lehman and Witty compared vocational interests at various ages and showed that such interests cannot be permanent. Thus boys choosing certain types of engineering ranged from 3 percent at ages eight and nine to 23 percent at about age sixteen. Maller (823) studied the Edison scholarship candidates, as compared with other high-school students, finding the Edison scholarship boys: more apt to come from homes of workers, farmers, and professional men, less apt to come from commercial occupations; more apt to have scientists in the family; more apt to own scientific apparatus; more apt to intend going to college; just like the others in the hours given to sleep, work, and recreation; more apt to choose engineering as a vocation, swimming as recreation, and experimentation as a hobby. The Edison scholars were almost twice as apt to believe present relations between capital and labor satisfactory (86 percent to 37 percent and 51 percent in two control groups).

Goodfellow (793) used the Strong Vocational Interest Test with prospective teachers and compared the A (possessing interests of successful teachers) and the C (not possessing such interests) groups. The A group were superior in academic average. The 18 A women were less introverted (Colgate), less emotional (Thurstone), more ascendant (Allport). Personality differences with the 12 men were not reliable.

Other New Tests

The following may be added to scales and tests mentioned in connection with specific projects:

Beyle (768): scale for measuring attitude toward candidates for elective governmental office.

Beyle and Parratt (767): scale for measuring severity of the third degree.

Israeli (806): measurement of judgments about the future.

Nystrom (831): measurement of Filipino attitudes toward America.

Remmers, Brandenburg, and Gillespie (838): measurement of attitudes toward the high school.

H. N. Smith (848): scale for measuring attitudes toward Prohibition.

Stauter and Hunting (851) tried out a test of social contacts based upon questionnaire asking for the number of persons in each of 191 categories (e. g., baseball fans, art students, Methodists, Frenchmen, etc.) who are known by name and who know the subject by name. Correlations with intelligence, psychology grades, and ability to associate pictured faces with names, were all low. Those mentioned in the college newspaper scored higher than those never so mentioned.

Stevick (852) tested conformity by asking subjects to encircle first what they believed, later what they thought most people believed. The more schooled were slightly more independent in belief ($r = .25$).

Katz and Braly (810) asked 100 students to select from a list of 84 adjectives the five which the students considered most characteristic of each of ten national or racial groups. In the case of negroes, 50 percent of the 500 votes cast were confined to five traits. The Chinese and Turks required twelve and sixteen traits respectively to include 50 percent of the poll, indicating less of the adjective-stereotype.

Israeli (805) found it interesting to ask students to predict divorce rates for years to come, and to give the most probable date for the decline of the West as described by Spengler.

Contributions to Technic

In his review of 125 titles on measuring attitudes, Droba (785) classified methods as: absolute ranking, case method, relative ranking, graphic rating, paired comparison, and the scale of equal-appearing intervals.

It has become accepted as good technic in making attitude scales to use Thurstone's method of equal-appearing intervals. Statements are sorted into piles (usually eleven) by judges. Statements which appear consistently in a given position may be chosen as representative of that degree of the attitude. The scale value of each statement is calculated. Hinckley (801) showed that statements on the negro were given approximately equal scale value whether sorted by northern or southern, white or negro judges. Wang (862) suggested sixteen criteria for the original selection of statements. Miller (826) criticized the Thurstone scale, because he found that the average person checked items ranging over 7.2 scale units while the scale itself had only 10.8 units in its entire range. He held that it is not justifiable to stop with the opinions of the original judges, but maintained that the actual responses of large voting populations should be used further to refine the scale.

The Bogardus Social Distance Scale (771) was built after asking 100 judges to distribute 60 statements indicating degrees of intimacy or social relationship into seven piles. Seven equidistant statements of situations were thus selected. Lists of 40 races, 30 occupations, and 30 religions have been prepared, with suitable instructions. Each is judged by whether people of that kind would be admitted to marriage, friendship, work, neighborhood, acquaintanceship, or citizenship. Zeligs and Hendrickson found nearly 90 percent agreement between the scale and personal interviews with 13 sixth-grade children. M. Smith (849) determined intimacy scale values for 16 statements of social distance as judged by 65 college students.

The question of the number of degrees of acceptance or rejection has been often argued and sometimes investigated. Pemberton (832) found the + 3 to – 3 scale the most reliable. Likert (821) in a careful study of attitudes on internationalism (24 statements), the negro (15 statements), and imperialism (12 statements) used some three point, some five degree, and some multiple choice responses. He found that the determination of sigma values for each of the five possible answers did not greatly improve reliability as compared with the simple method of counting 1 for the answer at one extreme, 2 for the next, 3 for the middle answer, then 4, and 5 at the far extremes. Reliabilities (split halves) varied from .80 to

.90, and retest after 30 days gave results just as high. Reliability of the Thurstone-Droba War Scale, scored by Likert's simple 1–5 method proved somewhat higher than when the regular Thurstone scoring was used. Complete directions for constructing an attitude scale are given in this monograph.

Comment

The reviewer ventures to offer the following suggestions for the improvement of some studies of social attitudes:

1. Let the study be an outgrowth of activity and thought in connection with major social needs. Scientific resources are too limited to be wasted upon the inconsequential.
2. Let the subjects and situations more frequently be found outside of college classrooms.
3. Let those data be collected which will check some hypothesis—one which has a good chance of being both true and significant. The random collection of personal data and test scores for correlation seems never to bring rich reward.
4. Let there be more attempt to find indices of social attitude which arise and validate themselves in the activities of the economic, political, and social struggles. Psychologists and educators have shown an inexcusable addiction to paper and pencil.
5. Let the necessary scale be constructed after much more thorough, intimate, and discriminating acquaintance with the best scholarship concerning the issue. Many of the so-called "radical" positions in existing scales, for example, would be disowned by any intelligent radical.
6. Let the refinements of accuracy in mathematical units wait until the many errors which common sense could eliminate have been removed. Statistical attack has too often substituted for, rather than followed upon, intelligent and thoughtful analysis of the actual behaviors involved.

CHAPTER VIII

Measures of Character and Personality Through Conduct and Information

THE studies for the period have been treated in four large divisions. The first includes publications primarily concerned with contributions to method. These are discussed under the headings of systematic observation, ratings, tests, expressive movement, psychogalvanic measures, physiological factors, inventories, and factor analyses. The second division represents an alphabetical arrangement of characteristics, traits, or constellations of behavior in which the investigator has been interested. The patterning of character and personality measures has been reserved for the third section. Studies stressing the prediction of achievement and the relationship between variables are included here. Investigations of the effect of direct or indirect instruction on knowledge or modification of behavior have been discussed in the fourth large subdivision.

CONTRIBUTIONS TO TECHNIC

Systematic Observation

Growth in the development of time-sampling technics was described in the summary of seventy-six titles by Olson and Cunningham (997). The emphasis on overt behavior and the range of problems attacked was illustrated in a list of thirty-eight categories of behavior to which the approach had been applied. Practices employed in time-sampling studies were discussed under the following headings:

1. Definition of behavior: action criterion, impression criterion, social-stimulus criterion, unit of behavior, category
2. Timing and sampling: time-sample, distribution of time-samples
3. Distribution of observer's attention: individual observation, group observation, scanning
4. Method of recording: intermittent recording, continuous recording, photo-recording
5. Method of scoring: time-sample score, frequency score, derived score
6. Conditions of observation.

Bott (889) has summarized in discussion and tabular form the practices in some of the major observational studies as to the selection of categories, the quantification of measures, devices for recording, methods for measuring reliability, and methods of expressing results.

The development of recording technic has been illustrated in the stilled motion pictures of D. S. Thomas, Loomis, and Arrington (1020), the photo-sampling of Olson and Wilkinson (995), and the intermittent photography of Swinton (1018).

The period has also witnessed an increased advocacy of what might be termed anecdotal, diary, or journal types of recording. A single observation represents measurement in the sense of presence or absence, and may preserve more of the matrix from which the behavior emerges than more delimited or controlled observations with established reliability. In general, such observations have been employed for their guidance and counseling values rather than for measurement, research, or controlled appraisal. Notable studies have been made and others are in progress making more systematic use of records of incidental material. Space requirements and the task of this *Review* have dictated the elimination of the numerous studies pursued by informal methods of observation.

Ratings

Rating methods have very definitely grown in favor during the period covered by this *Review*. Weiss (1025) reviewed 131 titles dealing with both self-ratings and ratings by others. Her opening paragraph is of interest:

> Whether we like it or not, rating scales are forging their way into research circles. Not only are they of value in lieu of more objective measures, but they are being found applicable themselves with a relatively high degree of objectivity. The supposed death blows first dealt them by Rugg and Thorndike have proven only temporary checks. What then seemed unavoidable flaws have now been found remediable through development of new techniques (1025: 185).

Conrad published a series of articles (906, 907, 908, 909) in which he discounted the importance of many of the factors which have been regarded as disadvantages of the rating method. His setting was the nursery school where superior conditions for observation exist, as contrasted to the casual limited contracts typical of certain work or educational situations at later levels. In addition to showing that valid and reliable data may be secured, he called attention to a problem which has been somewhat overlooked in rating. Studies hitherto have tended to emphasize differences among traits, among raters, and conditions of rating. By treating the trait ratings on each subject as a sample, he is able to show that the reliability of rating is in part a function of the child; i.e., some children can be rated reliably, others not so reliably, and a given trait may be rated reliably in a child of outstanding characteristics, and unreliably where the trait is not particularly applicable to the child.

The trend from both direct observation and rating suggests that an eyewitness record of behavior or a rating judgment based on the impression from a series of events may possess more validity than an abstracted questionnaire or test instrument from which one must infer a relationship to the behavior. The disadvantage of the direct approach is the inconvenience of securing the record and the inaccessibility of certain aspects of the experience and personality to direct observation.

Tests

Investigators have continued to employ the tests, or modifications of test technics, developed by May, Hartshorne, Maller, and others. The Character Education Inquiry was largely completed and reported in the *Review of Educational Research* for June, 1932, on character and personality tests. The new tests involving performance or information have been reserved for topical treatment later in the chapter. Measures involving self-rating or reporting have been described in the two preceding chapters.

Expressive Movements

An increasing number of attempts are being made to generalize more widely on the specific data of peripheral expression so as to regard voice, gesture, graphology, and movement as reflections of well-organized dispositions in personality. The descriptive and analytic studies have been omitted in conformity with the general purpose of the present *Review*. The journal, *Character and Personality*, is the most prolific source for both European and American contributions to the study of expressive movement.

A survey of the literature and experimental work in the book by Allport and Vernon (877) constitutes a useful beginning for students of the problem. Part A treats the problem of the consistency of individuals in respect to their style of expression and their habits of gesture. Experiments were conducted to measure speed, tension, extent, variability, pressure, and other peculiarities of natural movement. Intercorrelations were presented between a variety of measures in search for group factors. A need was shown for the interpretation of certain types of data in terms of psychological equivalents, for there was some evidence that "measures which do not correspond statistically may nevertheless be congruent psychologically." Part B reviews critically recent experimental work in graphology and presents two experiments designed to test the skill of graphologists and laymen. The writers have a feeling that perhaps too much has been claimed for graphology by graphologists and too little by psychologists. Both gesture and handwriting reflect an essentially stable and constant individual style. Experimental material on handwriting has been brought into closer relationship with personality traits (899, 943), or given special study from the point of view of the reliability of interpretation of the material itself.

In general, studies of body type have been excluded from the present *Review*. From the point of view of expressive movement, however, the traces left in the face by habitual expression, typical posture, and methods of walking and running must be regarded as evidences which can be tested, even though the validity for personality study is not always clear or demonstrated.

Blake (888) studied bodily expression, excluding the face except as added information for the interpretation of the data. Subjects were supplied with five sheets with nine pictures on each sheet. The sheets represented the human figure in various poses, and with the figure divided so that expressive movements by head and shoulders, torso and arms, feet, legs, and hips, full figure without face, and full figure with face could be studied separately. For each sheet, the subject was required to give nine responses as to whether the figure showed horror, frenzied anger, feebleness, tenderness, antagonism, stealth, egotism, embarrassment, or resignation. He concluded that one tends to interpret certain bodily expressions as indicative of certain dominating mental or emotional states, and that the ease of so doing increases as the number of bodily agents involved increases. Further, he contended that there is an improvement with training, and that adults exceed children in the ability. Blake pointed out that, regardless of origin, bodily expressions constitute a part of the problem of human relations and may be developed or modified consciously for these ends.

Further evidence of the importance of expressive movement is found in the study by Goodenough (934) of the judgment of emotional states in infancy. Eight photographs representing infantile emotions were submitted to 68 students in child training courses, together with descriptions of the states. The students were required to match the pictures with the descriptions. Correct judgments were made in 47.4 percent of the cases, which is 5.7 times the number expected by chance. It is possible that such emotional expression may be more readily observed before the age of learned inhibitions and substitutions.

Psychogalvanic Studies

The psychogalvanometer has played and is playing an important role in the literature of personality studies. Landis (963) reviewed 247 titles covering the literature from 1929 to May, 1932. It is clear from the review that persons interested in applied uses cannot expect much immediate help from these instruments. The interest and value of the technic from the point of view of research are obvious. Landis' conclusion for the time being is of interest:

> From this literature, giving the results and conclusions of many investigators, the reviewer is convinced that there is really no adequate evidence that these electrical phenomena of the skin are of necessity associated with any psychological event. They are, as Wang pointed out, strictly physiological in nature and probably have a marked and important psychobiological significance. There is really no justification for anyone using any present galvanometric technique or method as a measure of, or a criterion of any of the traditional psychological categories, personality traits, or social relationships of the individual (963: 275).

Many investigators have found, as in the case of Darrow (968: 57-261), that the correlations between various questionnaires concerning emotionality and the psychogalvanic responses often tend to be sufficiently large to indicate a group trend, even though not significant for individual prediction.

Physiological Studies

Investigations into personality by physical and physiological technic were reviewed by Larson and Haney (966). They submitted a lengthy bibliography and described some of their own work by means of the polygraph technic (see later section on lying). By using a falling chair device, Ray (1007) demonstrated that real changes appear in the pulse rate, respiration, and inspiration-expiration ratio of children. Investigators interested in body chemistry as indexes to personality should examine the review by Rich (1008). Acid-base equilibrium and creatinine production appeared to be definitely related to emotional excitability, although the explanatory interpretation is not yet clear. Experiments dealing with calcium and phosphorus have usually been equivocal or negative. Children showing behavior problems appeared to be somewhat more likely to show endocrine disorders according to the investigations of Rowe (1011).

Reference should also be made here to the attempt to relate food and character (885) and to the compilation of references to psycho-dietetics by Fritz (928).

Inventories

Inventories furnish a point of departure for the construction of various types of instruments for the study of character and personality. Useful ones have been prepared by Ackerson (873, 874) on the basis of behavior problems of children, by Conrad (905) for behavior ratings of nursery school children; by Krout (962) for gestures; and by Allport and Vernon (877) for expressive movements. Baumgarten (882) listed an inventory of character traits with 1,629 terms in connection with her study of character traits. The social setting of personality problems was emphasized in Cantril's review (900) of 306 titles which cover such topics as fads and fashions, conversation, humor and laughter, imitation, suggestion, creeds, revival meetings, legends, patriotism, gossip and rumor, religious cures, friendships, leadership, customs, clothing, newspapers, radio, race attitudes, language, revolution, and industry.

Factor Analysis

Thurstone (1021) reported his work on multiple factors in his presidential address before the American Psychological Association in September, 1933. He pointed out the inadequacies of Spearman's two-factor or single-factor method in accounting for the multi-dimensionality of mental traits. As illustrative material, he employed a number of specific studies of personality—one on a list of sixty adjectives descriptive of personality, which yielded five group factors; one on the insanities, with the whole range of psychotic symptoms reduced to five clusters; another on the vocational interests of college students; and a fourth on radicalism as a common factor. Spearman has published requests in several countries for cooperative work in personality investigation. Studies under the plan have been begun in the United States.

Maller (980) has studied the intercorrelations of four growth scores for honesty, cooperation, inhibitions, and persistence, contained in a study by Hartshorne, May, and Maller. They are uniformly positive and suggest the presence of a general factor in character. The writer believes that this general factor is the readiness to forego an immediate gain for the sake of a remote or later gain.

Jenkins and Ackerson (956) described card-sorting methods for tracking down types of clusters of individuals with characters in common. The method is applicable only to large bodies of data. As applied to behavior problems of children, it is possible to secure clusters of items in which the obtained frequency of association exceeds the chance expectancy.

CHARACTERISTICS, TRAITS, AND CONSTELLATIONS OF BEHAVIOR

ASCENDANCE-SUBMISSION

Self-report methods of describing ascendance-submission, extroversion-introversion, domination-compliance, or similar characteristics are included in another chapter of the *Review*. Jack (955) investigated ascendant behavior in four-year-old children by means of an experiment made up of a series of pairings. Factors differentiating between the upper and lower third were studied.

By comparing the actual performance of sixteen nursery-school children in six test situations with their self-assurance in these situations, Emmons (920) found that self-assurance was positively correlated with skill, age, and intelligence.

Delinquency

Several new instruments for the measurement of delinquent tendencies have appeared and a much larger group of studies describe the application of earlier tests and ratings to groups of children differentiated as problem and non-problem or delinquent and non-delinquent. Loofbourow and Keys (973) published a battery of four tests known as the Personal Index. The battery was based upon a study (974) in which ten group tests of behavior tendencies were applied to reformatory inmates, to groups of junior high-school boys designated as disciplinary problems, and to public school boys of like age and intelligence. Burrow (894) developed a social rating sheet containing twenty-five desirable attitudes and traits for the study of behavior problems among backward pupils in a special school.

The research literature developing about the use of the Haggerty-Olson-Wickman Behavior Rating Schedules has been summarized to April, 1933 (998). Statistical inquiries and clinical uses in schools, courts, and guidance clinics are described. It seems clear that the schedules have validity for the prediction of the constellations of behavior which bring children into conflict with the mores of social groups and with the machinery of the juvenile court.

Delinquents have been found to have a higher social participation rating than non-delinquents (879), and to secure markedly higher average scores on the Sims Scale (1019). Holsopple (953) suggested that recidivism may be related to an inability to inhibit or unlearn behavior habits. There is some evidence for a small group that mirror drawing is an index to this ability.

The studies contrasting delinquent and non-delinquent children furnish interesting material on the general question of the validity of personal report methods as contrasted to rating, and as to the relationship between knowledge and conduct. Using the personal report method, Babcock (880) failed to find a differentiation using Attitude SA Test, Sweet Test of Personal Attitudes in Young Boys, Roger's Test of Personality Adjustment for Boys, and various perseveration tests of Stevenson. Mira (987) concluded, on the basis of tests involving information, ethical discrimination, and conduct, that: "These data demonstrate that the correlation between the tests of theoretical conduct is small; that between theoretical and real conduct is nothing; and that between the tests of actual conduct in face of situations which require the possession of the same moral characteristics but expressed in two different forms (action in one case and inhibition in the other) is highly satisfactory."

The differential capacity of twenty-four different tests was studied by Casselberry (901). The index finally obtained apparently is predictive of success on parole. He found the Laslett-Casselberry Free Association Test one of the most discriminating items in the battery. However, Gilliland and Eberhart (932) did not find such clear-cut differences on the Laslett test in comparing four groups representing different degrees of delinquency in the Chicago area. They surmised that there may be considerable differences in the vocabulary of delinquents in different parts of the country, which may interfere with the comparability of the results.

Hill (951) measured the extent of cheating by a technic similar to that used by Hartshorne and May. Delinquent children in a reformatory were differentiated from a problem group of junior high-school boys and from a group selected as well adjusted. There was little difference, however, between the two high-school groups.

Inconsistencies in the differential capacities of the same test in different studies are probably attributable to variations in the extent to which age, sex, and mental ability have been controlled. In certain instances, a spurious differential capacity has undoubtedly been attributed to certain tests by basing the conclusions on the criterion group which was employed in its construction. In such a comparison, a newly constructed test will show up favorably as compared to others, and may fail to hold up equally well in new applications.

Character and Personality Scales

Many of the rating devices intended for use in the home and school are organized in batteries designed to give a many-sided description of personality. They cannot, conveniently, be treated under a topical organization.

Hayes (945, 946) published a scale for evaluating the school behavior of children ten to fifteen. Raters are asked to check a series of statements concerning each child. The statements are concerned with relations to others, to the rights of others, to teachers, to other pupils, initiative, health habits, general interest, scholarship, and study habits. The items are scored in terms of weights based upon the judgment of experts as to their desirability or undesirability for character or personality development. The scores are then translated into percentile ranks by divisions and a profile constructed. The same principle was employed in a variation of the scale having an age range of nine to fifteen and designed particularly for parents (944). An extension was later developed by Hicks (949) for use by parents of children six to nine.

Maller (979) developed a rating scale including fifty aspects of character and personality. Each is followed by a brief description divided into three sets—low, average, and high. The actual rating is done on the record blank which accompanies the scale. Williams (1026) analyzed essay reports by teachers as a basis for the construction of a rating form for pupil adjustment in a laboratory school.

Developmental Age

Furfey's previous test for developmental age has been revised to simplify scoring and increase reliability (929). The test consists of 196 pairs of items on things to do, things to have, books to read, etc. The subject chooses one of each pair. Developmental age as determined by shift in choices does not appear to increase after sixteen. Developmental age equivalents for scores are reported. Reliability of the revised test ranges from .85 to .96 in the various age groupings.

Measures of developmental age are now available for girls. Plechaty (1003) reported a preliminary form of an objective scale for measuring developmental age in grade-school girls. Sullivan (1017) described a scale based on characteristics and changing interests of girls from seven to eighteen years of age. The method of choice of paired comparisons was again utilized. Developmental age increased steadily to the sixteenth year in girls, with no abrupt change at puberty. Changes are not so regular after the sixteenth year.

Emotions

The amount of tension in the muscles of the used and unused hands, while making responses to pictures and while tapping, was shown to be related to ratings on excitability and to school adjustment in the investigations by Duffy (915, 916, 917). Tension in the hand muscles was measured by a dynamograph. Such a measure may be useful in determining which individual frequently manifests a highly aroused state. By combination of time-sampling and graphic rating, Lee (971) concluded that instability of mood and mood level were measurable characteristics of nursery-school children. Goodenough (933) quantified data on the frequency, duration, causes, and methods of handling anger outbursts of children in the home.

Eating Behavior

Eliot (919) studied the personality pattern which differentiated finicky and non-fiinicky eaters in nursery schools. A rating scale of thirty-one items was developed in which trait names were used but in which the quality to be rated was described in terms of habits of action. Thirteen out of thirty-one traits were found from which reliable distinctions were obtained. Finicky eaters among two- or three-year-old children seemed to have poorer general health, to be more emotional, self-assertive and self-expressive, and less well adjusted and happy than non-finicky eaters.

Friendship and Quarreling

Friendship and quarrels have been a popular topic for investigation by students of preschool children. The usual approaches involve variations of time-sampling and systematic recording which define friendship and companionship on the basis of propinquity and frequency of associations. The measured data have been interpreted in the light of sex differences, age differences, and other measurable characteristics of the children, see Challman (902), Green (936, 937), and Hagman (939). Mengert (984) secured measures of friendliness and unfriendliness in a group of two-year-old children by pairing each child with each of the other children and noting their reactions.

With older children, Flemming (925) demonstrated a similarity between the scores of students and best friends on various measures of personality, intelligence, and social status.

Honesty

G. F. Miller (986) intentionally misscored the test papers for two groups of college students. The students were then given an opportunity to correct their papers with a key. One-fourth of the total papers had been scored too high by the instructor and another one-fourth too low. He was thus able to note the extent to which students would correct errors which raised their scores as compared to errors which lowered their standing. The per cent of honesty was 7.7 for a younger group of students and 58.3 for a more mature group. Tuttle (1024) obtained a measure of honesty in terms of changed answers in a well-motivated school contest involving over 2,000 children in the elementary grades of thirteen different schools. The results indicated a high correlation between honesty and intelligence and an increase in honesty from grade to grade. Data by schools are construed as indicative of a relationship to geographical area. E. H. Moore (989) described a method for measuring honesty in classroom performance.

The Presseys (1004) compared the honesty of Indian and white children in the third, fourth, and fifth grades as measured by the scoring of an arithmetic paper, handling money, performance with the eyes closed, and individual records of results on the hand dynamometer. In general, Indian children appeared to be less honest than white and there was a decrease of dishonesty with age.

General interest in the detection of crime makes the monograph by Larson and others (967) on the detection of lying particularly timely. Questions are given to the subject to which he must respond by "Yes" or "No." The inference as to lying or guilty knowledge is made from a polygraph record involving pulse rate, blood pressure, respiratory rate, and the psychogalvanic reflex. The instrument employed was based upon earlier devices with improvements by Larson and Darrow. At times the record has been used to obtain a confession. Devices of this type are being brought into general use over a wide area, and their validity and reliability have probably been exaggerated in popular thinking. The sensitiveness of the instrument to a variety of physical and physiological changes makes it desirable to restrict its interpretation to skilled persons.

Humor

Humor scores were obtained by Landis and Ross (964) by asking subjects to rate a carefully selected list of 100 jokes as to excellence. No significant relation was found between the humor score and intelligence or introversion.

Leadership and Popularity

The time-sampling method was employed by Parten (999) in a study of leadership among preschool children. Even at the preschool level there appear two types of leaders—the diplomat and the bully. The former controls a large number of children by indirect suggestion; the latter employs force.

Koch (960) used the method of paired comparisons applied to expressions of preference by members of a nursery-school group of children to obtain a popularity score for each child. These scores correlated .76 with the ranking made by the teacher. Popularity scores tended to be higher for girls than for boys and positive correlations are shown between the measure and compliance with routine, respect for property rights, a tendency to ask for commendation, and a tendency to tattle.

Leadership among adolescent boys has been studied by Partridge (1002) in the summer camp and scout troops by means of a five-point man-to-man rating scale. Leaders were found to excel their fellows in all measures of mental and physical traits but did not tend to fall into definite types. The bibliography of 143 titles is of value to the investigator. Jenny's study (957), using tests and attitudes scales, indicated that in the summer camp the most acceptable boys were well adjusted, resourceful, and capable of leadership. Non-acceptable boys tend to be problem cases.

In Garrison's investigation (931) students were given instructions to list in order the five individuals of the class, boys or girls, that they admired most. A leadership score was obtained by means of weighting positions held in high school by each senior during the past three years. Marked correlations were found between the admiration score and the leadership score and significant relationships between scholarship and leadership scores. A small correlation was found between the father's occupational rating and the leadership score.

Flemming (926) obtained pleasing personality ratings from classmates. These ratings were then correlated with other measures and ratings of traits obtained from the teachers. Pleasing personality was found to be positively related to intellectual enthusiasm, capacity for independent thought and for independent work, industry, persistence, social adaptability, rejective ability, dependability, self-control, and good manners.

Cowley (910) gave 12 psychological tests to 112 subjects consisting of criminal leaders and followers, non-commissioned officers and privates in the United States Army, and student leaders and followers. In general, leaders rated themselves higher in self-confidence. They scored higher in motor impulsion and took an appreciably shorter time to: (a) determine whether their decisions would stand; (b) arrange a set of mottoes about tact; (c) call out the length of lines on a pack of 70 cards; and (d) arrange a set of mottoes about aggressiveness.

Negativism

The resistant, acquiescent, and aggressive behavior of thirty-six nursery-school children toward other persons was measured by controlled observation of activities, by stenographic reports of language, and by records of each child's behavior during intelligence tests (897).

A test for susceptibility to majority opinion was devised and presented by Barry (881) on the basis of earlier work by Moore. Individuals tend to change previous judgment to conform to the majority opinion. Striking individual differences were found in susceptibility. "S" was designated as a measure of negativism and compliance. Persons with low scores in "S" tended to be critical, derogatory, and irritable, and persons who were themselves irritable tended to rate others in a similar fashion.

"Only" Children

Theory has tended to emphasize the importance of being an only child as a personality determiner. Campbell (898), in summarizing 75 titles on the problem, concluded that research, both clinical and non-clinical, gives less and less support to this viewpoint. More analytical and well-controlled investigations are needed to establish the significance of "onliness" as such (also see discussion in Chapter VI). Witty (1027) studied 153 only children five years of age. Comparisons were made between ratings and measurements of this group and various control groups. Only children show themselves superior to other children in health, physical development, intelligence, and character traits.

Play

Play furnishes a rich setting for observational and experimental studies of character and personality. There is apparently no tendency to study play as a continum of personality in itself. Factors which make for participation or lack of it have been investigated. Hurlock's review (954) of 128 titles of experimental investigations of childhood play are the readiest source for the student.

Recklessness

Burtt and Frey (895) have developed a battery of tests for the measurement of recklessness. The tests involve such things as balancing a long rod, putting nuts on machine screws, and filling graduates with water to a designated mark. The criterion with an estimated reliability of .86 was obtained by means of a graphic rating scale. The items of the test, properly weighted, correlated .60 with the rating. Factor analysis of the inter-correlations suggests that the principal element is one of haste.

Social and Ethical Information

Several instruments for the measurement of knowledge of social standards have appeared during the period. That by Tomlin (1022) is applicable to children in grades four to eight. Reliability and validity data are supplied.

The test of social usage by Strang, Brown, and Stratton (1016) is particularly applicable in junior and senior high school. It covers table manners, taste in dress and appearance, good manners for the guest and host, good form in relation to others in social and play situations, and respect for property. Strang (1015) demonstrated that there is an increase in knowledge with age and grade, a positive correlation with intelligence, and a significant difference in favor of children whose parents belong to professional groups. No data have been supplied to validate either of the foregoing tests in terms of overt action.

The Shields' Moral Judgment Examination (972) yields an age score called "age of responsibility." The test involves vocabulary, comprehension in ethical situations, definitions, offense comparisons, sentence construction, and judgment.

The ethical concepts and feelings of 20 boys thirteen and fourteen years of age, were given intensive study by Hermsmeier (948). Evaluations made by the experimenter on the basis of test situations show a high correspondence with estimates of parents and teachers. Ethical concepts were tested by the use of definitions, the subsumption of anecdotes, under concepts, and the differentiation of paired examples of ethical qualities. Eight other methods were also used to arrive at measures of ethical feeling or information.

Socio-Economic Factors

Chapin (903) developed a Social Status Scale, 1933, which is briefer and simpler than the Living Room Scale, 1931, while still comparable in reliability and validity. An abbreviated form based upon the personal report method of the Sims scale was prepared by Wrightstone (1031). A scale for social adequacy was developed by McCormick (976, 977) on the basis of the type of data sought by social workers.

A plan for scoring the opportunities provided by parents for the development of money experiences of children was presented by Hanson (941).

Studiousness

It would appear that only a few of the many procedures advocated for methods of study actually differentiate between superior and inferior college students. Using self-ratings, Eurich (921) studied the relationship between study habits and achievement. Nine of the characteristics apparently differentiated well between groups of superior and inferior students.

Wrenn and McKeown (1028) selected the study habits which differentiate best between students equal in intelligence and unequal in scholarship. These have been published in their *Study Habits Inventory*. The items are weighted in terms of their differential capacity and yield a total score to describe the adequacy of the student's general work habits.

Vocalization

With the development of radio broadcasting, renewed interest has been evident in the judgment of personality from the voice. Allport and Cantril (876) had listeners judge both physical and personality traits by listening to the natural and broadcasting voice of the speaker. They concluded that the voice does give some correct information concerning the outer and inner characteristics of personality. The tendency toward stereotypy is shown in the fact that uniformity of opinion is somewhat greater than accuracy as judged by actual measured data on physical and personal traits. There was more consistency and correctness in the judgment of inner characteristics than in the judgment of outer characteristics.

Time-sampling technics applied to the measurement of talkativeness in children have demonstrated that reliable measures may be secured (1010). The study by Robinson and Conrad differs somewhat from that of Schubart (1012). In the former, presence or absence of talking in a given time period was the unit of measurement, while in the latter a mechanical counter was also used so as to secure a measure of total output and rate.

Brackett (891) found that the laughing and crying behavior of preschool children could be measured reliably by the use of direct observation and short-time samples. Laughter appeared to be a highly consistent pattern of behavior in varying situations and is somewhat more social than crying. Laughing tendencies increased with age in the preschool group while crying decreased. Justin (958) investigated laughter-provoking stimuli over an age range. Her method of procedure, involving timing, permitted quantitative measures with a consequent study of age change in relation to other characteristics such as intelligence. Thirty-six references add to the value of the study for the investigator. Kenderdine (959) also studied laughter in the preschool child. Ding and Jersild (914) have reported on the same behavior in the Chinese.

Shirley (1013) measured manifestations of irritability in infants during physical, anthropometric, and psychological examinations. An elimination of screaming, crying, fussing, etc., is shown with age during the early days, weeks, and months. Timed records of laughing, crying, etc., were used by Bridges (893) as measures of emotionality in infants.

THE PATTERNING OF CHARACTER AND PERSONALITY MEASURES

Achievement

The unique contribution of character and personality data to the prediction of achievement has been the subject of a number of investigations. The negligible relations between symptom questionnaires and achievement have been noted in Chapter VI. These are in contrast to the definite relations found by the use of action criteria.

Sorenson (1014) made a correlational analysis of the relationship existing between academic grades, industrial grades, intelligence, mechanical ability, mechanical interests, and problem tendency scores on Schedule B of the Haggerty-Olson-Wickman Rating Schedules in a study of junior high-school children. He found the highest correlation between the intelligence test and average grade (.62), with the relation to Schedule B scores next (–.55). Marks could be predicted three semesters in advance with Schedule B, with only slightly less accuracy (–.51) than that for the semester in which ratings were secured. Schedule B scores, academic grades, and paper form board scores predicted industrial grades about equally well. By partial and multiple correlation technics, Sorensen concluded that scores on Schedule B give a unique contribution to the prediction of school marks in a junior high school.

Turney followed his intensive monograph report (1023) on the relationship between character traits and achievement with a series of articles. In general, he concluded that between marks and the traits of industry, perseverance, dependability, and ambition, the correlations are as high or frequently higher than the correlations between I. Q. or mental age and marks. The correlations between traits and marks are but little affected when intelligence quotient or mental age is held constant. He held that the ratings are real measures of aspects of the personality which contribute to achievement. Intercorrelations between ratings and intelligence, vocabulary, scholarship, honesty rating, and objective test rating were made by Garrison and Howell (930). Reliable positive correlations were found between the various character traits and scholarship.

Hicks and Hayes (950) used a coded time-sampling method to record the verbal responses of junior high-school pupils in classroom discussions. The verbal responses were classified in terms of their content in subjectmatter and the extent to which they represented desirable and less desirable aggressiveness. These values were then compared for four groups of children made up on the basis of combined ranks in general intelligence, school achievement, and general personality traits. Command of subjectmatter and desirable aggressiveness were characteristic of the higher groups, and lack of command of subjectmatter and undesirable aggressiveness were characteristic of the lower groups.

McElwee (978) contrasted accelerated, normal, and retarded children in a public school on a checklist filled out by teachers. On the average, the accelerated children seemed to possess a greater degree of all the desirable traits than did the retarded children. Laycock (970) contrasted superior and inferior children on ratings of maladjustments made by teachers and ratings made by himself on the basis of personal interviews with the children's parents. In general, the superior group received more desirable ratings by both approaches.

The trend in secondary schools has been confirmed by Hartson (942) at the university level. He gathered data for 500 students on college freshman grades, high-school grades, psychological examinations, and ratings for eleven items in a personal rating scale. The eleven items had been rated by the students' high-school principal, a teacher, and a friend. Personality ratings correlated better with scholarship in high school than in college, and ratings by the principal correlated better than those by the other judges. The personal estimate as a whole yielded higher correlation with college grades than did high-school grades or intelligence test scores. A combination of high-school grades, intelligence scores, and personal estimate proved to be a better measure for predicting college scholarship than any one or a combination of two of the above items.

Ratings of twenty-five students by twenty-five others for beauty or physical attractiveness were found to correlate only very slightly with scholarship and not at all with intelligence in an investigation by Mohr and Lund (988).

It would appear that most external approaches to the evaluation of conduct and personality make a unique contribution to the prediction of general educational achievement. The evidence suggests the existence of a basic patterning and a possible central relationship in which achievement is but one of a number of peripheral expressions of the adjustment of the organism.

Complex Interrelationships

Typical studies in the patterning and interrelationships of behavior involve measurement by short-time samples in social situations for a series of definable aspects of the total, including such matters as language, type of participation, amount of physical contact, etc., with further analysis by sex, age, and other measurable characteristics (878, 884, 935, 994, 1000).

Bott (890) gave intensive consideration to the problem of interrelationship in observational studies of social and material activities, verbal and motor activities, social relations among children, relations with adults, and personal activities.

THE MODIFICATION OF INFORMATION AND CONDUCT

Applications of measures of character and personality in the determination of the result of both direct and indirect approaches to the modification of character are increasing in number. The extent of this trend is probably not entirely apparent in current publications. An examination of lists of unpublished master's theses shows large numbers of small studies.

Reviews

The obligation of the present *Review* for a report on applications is reduced since the December, 1934, issue, devoted to psychology and methods in the high school and college, has a chapter on moral and character education by Symonds and Kirkendall. Some overlapping exists in the present account where desirable for the sake of continuity. Changes in attitude are discussed in Chapter VII of the present number of the *Review*.

General summaries of practices with technical evidence are available through bulletins of the Research Division of the National Education Association (993) and through yearbooks of the Department of Superintendence (992) and the Department of Classroom Teachers (991). Heaton (947) has produced a convenient exposition for practices and sources.

Direct Instruction

Clevett (904) secured positive findings in increased honesty in athletic contests (used as test situations) in an experimental group in which experiences had been utilized as the basis for a discussion of problems of character. The control group had a very formal program with no conscious character education. Zyve (1033) called attention to the somewhat specific character of the outcomes in honesty which accrue through the utilization of examination situations for instruction in integrity.

The work book by Charters, Rice, and Beck entitled *What's the Right Thing To Do?* was experimented with as direct instructional material by Cressman (911). The one group of seventh-grade pupils used the work book for self-study, a second with presentation and discussion of the problems by the teacher, and a third was used as a control. Character tests from the work book and from the Character Education Inquiry were given before and after the training period. Both instructed groups showed improvement and the one with the heaviest reliance on the work book ranked the highest.

Fifteen periods of thirty minutes each devoted to a study of principles of honesty produced some differences in information as contrasted to a central group in Hobson's study (952).

An increase in critical thinking was demonstrated by Biddle (887) as a result of a study by pupils of methods used in current propaganda. Experimental and control groups were used from the eleventh, twelfth, and thirteenth grades. Tests on gullibility were given before and after. A significant improvement was found in the experimental group as compared to the control group.

Robb and Faust (1009) found small but consistent differences in favor of an experimental group as a result of eight weeks' instruction in ethics in one section of a civics course as compared to another which had the usual instruction in problems of democracy. A second experiment with two groups of ninth-grade children, one of which received eighteen home-room programs devoted to the presentation and discussion of moral problems, resulted in inconsistent results. Lectures and conferences on the qualities and technics of leadership produced increased gains in experimental as contrasted to control groups in the investigations of Eichler and Merrill (918). Leadership was measured by the ratings of classmates.

Indirect Instruction

Participants in athletics achieved greater gains than spectators or non-participants in six tests from the Character Education Inquiry in one school, but failed to be differentiated from non-athletes by teacher ratings in two others (938).

Allen (875) analyzed the character outcome accruing in two methods of teaching plane geometry. One group was taught by the traditional recitation method and the other by individualized instruction. He concluded that the individual instruction group was definitely superior at the end of the year in mathematical achievement, with small but consistent gains in the direction of more emotional stability, extroversion, submission, self-sufficiency, honesty, broadmindedness, and less mathematical interest. Students of Latin scored higher in civic attitudes, pacifism, and liberalism in the investigation by Meek (983).

Mayberry (982) compared members of student councils in high schools with a similar number of paired students not members of the council. The results indicate that the council group was superior in the characteristics measured by the Upton-Chassell Citizenship Scale.

The relation of newer practices in schools to character and other outcomes was described by Wrightstone in a series of studies. Experimental practices in the social studies, for example, may be employed to develop students in the direction of liberal civic attitudes and beliefs (1030). A number of articles have been devoted to methods of appraisal (1029). The monograph report, which is now available, falls properly in the period of the next cycle of the *Review*.

Motivation

Cooperation and honesty tests were given to 215 pupils in grades seven and eight under both personal and social motivation (981). In general the subjects worked at a higher efficiency and were more deceptive when the score was to count for personal gain than when it was to count as a gain for the group. The same trend was reported by Forlano (927).

Effect of Organization Membership

Boy Scouts were not delinquent as often as non-Scouts in Fairchild's investigation (922) of 500 Scouts and 500 non-Scouts from ten communities. Scouting, however, cannot be credited with the differences since they tend to disappear when an equation for socio-economic factors is made. The same trend appears in ratings based upon twelve traits of character included in the Scout Law. The Fairchild investigation has been summarized by Dimock (913) with suggestions for desirable extensions.

Feder and L. W. Miller (923) attempted to evaluate certain phases of a comprehensive program of character education for boys. The "X" plan involved military training and an intensive program of active club work in which the children had participated for a period of from two to five years. Comparisons were made with health tests, citizenship tests, attitudes toward war, and behavior ratings. Boys trained under the "X" plan did not differ materially on the above measures from boys in general.

Summary

A detailed reading of the experimental studies on the modification of information and conduct impresses one with the dominance of individual differences over experimental factors operating through brief periods of time. Differences in persons at the beginning of experiments are usually greater than changes which can be expected. The experimental differences secured are often small and specific or inconsistent. No evidence has appeared which demonstrates that character or personality can be easily or rapidly modified. Some shifts in attitudes and information have been demonstrated with direct and indirect approaches. Future investigations should strive for larger samples, more complete appraisals of changes in information, attitudes, and conduct, and longer periods for the operation of the experimental variables.

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REVIEW OF EDUCATIONAL RESEARCH

Official Publication of the American Educational Research Association, a department of the National Education Association.

The contents of the REVIEW are listed in the EDUCATION INDEX

Volume V **October, 1935** **Number 4**

THE SCHOOL PLANT

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INTRODUCTION

In the first cycle of the *Review of Educational Research*, an issue dealing with school buildings, grounds, equipment, apparatus, and supplies appeared in December, 1932. That number covered the literature in the above areas up to July 1, 1932. However, in organizing this second number, effort has been made to cover the school plant field more completely than was done in the first number. To that end, certain additional topics have been included. The period covered in analyzing the literature under these additional topics extends previous to July 1, 1932, the date at which the first cycle ended. The title, "The School Plant," used for this number, more nearly fits this broadened scope than that used for the first number.

In the judgment of the writer, the most significant thing brought out by these two issues dealing with the school plant is the lack of basic research in this field. In fact, Chapter VII of this number, entitled "Types of Construction and Materials as Related to Original Cost, Maintenance, and Operation of School Buildings," has no bibliography because its writer found no research in published form on this topic. Here is an area in which there is an expenditure for construction, operation, and maintenance of approximately $500,000,000 a year in the United States, in which little fundamental research is available. Furthermore, there is now little concerted, continuous effort to explore this important field. The last chapter in this number of the *Review of Educational Research* deals with needed research in the school building and equipment areas.

Because of this lack of basic research, coupled with the fact that the planning and construction of needed school buildings cannot be delayed until the essential investigations can be carried out, much material based on judgment and experience has been included. This, the committee believes, will be helpful to those on whom the responsibility for the development of the school plant rests.

T. C. Holy, *Chairman,*
Committee on the School Plant.

CHAPTER I

Technics for Determining Housing Requirements in Elementary, Junior, and Senior High Schools

SINCE ALL PHASES of research on the construction, operation, maintenance, and equipment of school buildings are covered in other chapters of this issue of the *Review of Educational Research*, this chapter is confined to a review of studies related directly or indirectly to the determination of the number, type, and capacity of recitation rooms needed in planning a school building. The word "recitation" is used in its broad sense to include all rooms used for any kind of educational activity carried on as part of the daily educational program.

Upward of 6,500 titles of literature dealing with school buildings were examined, including the 6,084 titles and brief descriptions compiled by H. L. Smith and Noffsinger (28) and H. L. Smith and Chamberlain (27). From this examination 76 titles were selected whose brief summaries indicated that some type of research in school building planning might have been done. Examination of these 76 books and articles revealed that 43 of them were not research projects and these were, therefore, eliminated.

Of the 33 research projects remaining, 19 were unpublished master's theses. These were not reviewed, but are listed in the bibliography as an indication of the type of school building research being carried on in the various graduate schools of education. In many instances they may serve as a basis for further needed research in some special phases of school building planning.

Analysis of the available research on school building planning showed that it could be classified into five types of studies covering the three types of buildings. The five study types involved planning technics, utilization studies, reviews of plans, school building standards, and studies on the planning, equipping, or utilization of special rooms. Table 1 (p. 338) shows the distribution of these studies according to type of study and building, the symbol "X" being used for reviewed studies, and the symbol "M" being used for master's theses, not reviewed but listed. The studies reviewed are discussed in the reverse order of the listing of types in the table.

Special Rooms

Brodshaug (2) made a highly specialized study of plans and equipment for teaching home economics in junior high schools and senior high schools in cities of populations of 10,000 to 500,000. His procedures involved a review of literature, an analysis of city standards, visitation of many home economics plants, and interviews with school authorities.

Three of his outstanding conclusions are:

1. The home economics curriculum is in a process of rapid and varied transition, and leaders are far from any agreement as to what is proper curriculum material. This condition makes it difficult to plan a suitable plant layout which will not immediately become obsolete.

2. In the schools visited the average number of pupil stations provided in laboratories was twenty-four. The junior high schools were almost standardized in this respect.

3. Thirty-five square feet per pupil was the approximate average in foods laboratories and clothing laboratories in the thirty-nine schools. This is generally regarded as satisfactory by state standards. If a demonstration area is desired in the laboratory, forty square feet is recommended.

TABLE 1.—DISTRIBUTION OF RESEARCH STUDIES ON SCHOOL BUILDING PLANNING

Types of research studies	Elementary-school buildings	Junior high-school buildings	Senior high-school buildings
Planning technics		X	X–X–M–M
Utilization	X–M	X	
Review of plans	X–X–M	X	M–M–M
Building standards	X	X	
Special rooms	X	M–M	X–X–X M–M–M–M M–M–M–M M–M

Heywood and Rust (13), basing their judgment largely upon experience and observation, set up a list of characteristics of satisfactory home economics laboratories and classrooms, including space requirements for schools of various sizes. The research value of this contribution is doubtful. Flemington (10) and McCulloch (19) wrote master's theses on the planning and equipment of home economics rooms. Both studies were surveys of existing practices.

Green (12) studied the type, location, and space allotment of commercial rooms in 125 of the largest high schools in the North Central states. The typical commercial suite was arranged as a unit, centrally located on the second floor, and contained rooms for bookkeeping, typing, stenography, and commercial recitation. The bookkeeping room contained 640 square feet, the stenography room 725 square feet, and the typing room 690 square feet. These rooms were equipped for 36, 37, and 42 pupils respectively. The commercial recitation room was a standard unit of 660 square feet.

Soper (29) made a utilization study of the elementary-school auditoriums in New York state. According to the opinions of school heads answering the questionnaire, auditoriums located in basements or on third floors are practically useless for educational activities. No recommendations were made as to the size of auditorium in relation to the size of school. Coleman

(4), Douthirt (6), Evans (7), Lohmoelder (16), A. Smith (26), and Winters (34) wrote master's theses on some phase of the planning and utilization of auditoriums and gymnasiums.

Two theses, one by Lightfoot (15) and one by Lundgren (18), presented surveys of the housing, equipment, and materials used in industrial arts departments in the Los Angeles junior high schools and the class A schools in Kansas, respectively. Two other master's theses listed on the planning of special rooms are the one by Rowe (25) on the survey of music departments in the Bay district of California, and the one by Carnes (3) on the natural science laboratories of Florida high schools.

Building Standards

The two outstanding recent contributions on school building standards are by Strayer and Engelhardt (31) on elementary buildings, and by Holy and Arnold (14) on junior high schools. Strayer and Engelhardt have again revised and enlarged their elementary building standards originally published in 1916. The study by Holy and Arnold was based upon the consensus of opinion of experts as to what should constitute ideal housing conditions for a junior high school.

Reviews of Building Plans

Goldthorpe (11) analyzed the floor plans of 94 junior high-school buildings, 43 of which plans were published in the *American School Board Journal* in 1920-24, and 54 in 1925-29. The buildings were distributed from villages of 1,000 population to cities of 1,000,000 population. Half the buildings were located in cities of 10,000 to 100,000 population. One hundred sixty-six types of educational space provisions were found. Two-fifths of the buildings provided study halls; twice as many of the schools making such provision were above the 1,000 pupil capacity as below that capacity. The chief conclusion was that buildings planned for less than 700 enrolment were limited in the types of educational facilities provided.

Pittenger (22) analyzed 70 floor plans of elementary buildings as presented in the *American School Board Journal*. He found the classroom the only type of facility common to all plans analyzed. The tabulation of spaces was made with the buildings grouped according to number of classrooms, with 5 to 16 rooms in the first group, 17 to 36 in the second group, and 37 to 83 in the third group. Pitkin, Oberholtzer, and Strayer (21) made a similar analysis of 20 elementary building plans published in the *School Executives Magazine*. The sizes and features of instructional and non-instructional rooms were noted. Two kindergartens of special features were described, but no interpretation of data that might lead to better planning was made.

Four master's theses, by Lowry (17), Younger (35), Powers (23), and Spohn (30) have been written recently on the review of school building plans. Lowry found 317 planning errors and 345 structural errors in six buildings. Younger made a study of the space provisions of 64 high-school building plans. Powers made a similar study of elementary- and junior high-school plans of 1910, 1920, and 1930, to determine changes and trends, while Spohn made a similar study of 24 high-school building plans of 1907, 1917, and 1927. He found rapid changes in 1927, especially in commercial and home economics rooms. Classrooms, libraries, auditoriums, physical education rooms, and shops showed less change.

Utilization

Fink (8) used a simplied form of the Morphet technic for studying the utilization of 89 elementary buildings in Minneapolis. Only instructional rooms were measured. The teacher-station utilization of buildings varied from 45 percent to 86 percent, with a median of 78 percent. Pupil-station utilization varied from 41 percent in one building to 81 percent in another, with a median building utilization of 68 percent. These percents were considered high by the author. Pugh (24) made an intensive study of the utilization of one junior high-school building. The pupil-station utilization of all instructional rooms, exclusive of auditorium and gymnasium, varied from 29 percent in the cooking room to 93 percent in one homeroom and a like percent in the study hall. The pupil-station utilization of all rooms was 65 percent. The homerooms showed a teacher-station utilization of 91 percent. Pugh's conclusion was that increased enrolment in this school will necessitate better scheduling and dual assignment of the special rooms in order to obtain more efficient utilization. Devenport (5), in his master's thesis, reported on the utilization of 22 elementary- and three high-school buildings in Utah.

Planning Technics

Finley (9), in his master's thesis reported a study of practices of housing six-year high schools in Colorado. Mays' study (20) was on the necessity for (and lack of) efficiency in high-school building layout and arrangement. Neither of these theses was available for review.

Arnold (1) studied the better junior high schools of Ohio, obtaining from school administrators, supervisors, teachers, and janitors of those schools a consensus of expert opinion as to what facilities should be provided in a junior high school. He then prepared these results in the form of tentative standards for junior high-school buildings which he submitted to nearly a hundred architects and school building specialists who made further suggestions which he incorporated in the final report of his study. Arnold also devised a score card for evaluating junior high-school buildings in which he utilized the judgment of a large number of junior high-school principals as to the relative importance of the various features of the building and its equipment.

Wilson (32, 33), after a careful analytical study of the daily programs of some 400 high schools in New York state, ranging in enrolment from 50 to 400 in grades 9 to 12, together with a utilization study of the buildings occupied by these schools, found in that state a very high degree of relationship between the number and capacity of recitation rooms needed, on the one hand, and the enrolment of the school and the program of studies offered, on the other.

From the various detailed phases of these established relationships, it was possible to develop formulas and charts from which the optimum number and capacity of required teacher stations or recitation rooms, could be determined quickly for any high school of 50 to 400 enrolment, when the desired educational program was known.

Two assumptions underlie these findings:

> First, it was assumed that all special recitation rooms in a high school, with the possible exception of the boys' vocational arts rooms, could be so equipped as to be usable for certain types of non special recitations when not in use for the special recitations for which they were set up.
>
> Second, it was assumed that in a small high school it is neither economically sound nor educationally necessary that all the recitations of a given subject, as English, or mathematics, be taught in a room set apart for that subject alone, but that with proper equipment such non-special classes may be taught interchangeably in rooms best fitted to the size of the class reciting.

Throughout this study, rooms designed specifically to house non-special classes were called interchangeable stations, and rooms designed to house special classes were called special stations. These were the homemaking, shop, agriculture, science, typing, art, and music rooms, and the library or combined study hall-library.

The findings of this study, made applicable to the planning of a high-school building in New York state were summed up as follows:

1. High-school enrolment is so closely related to the number of daily classes and daily interchangeable classes to be expected, that the number of daily interchangeable recitations approximates very closely the formula

$$\frac{\text{Enrolment}}{8} + 12 = \text{Daily Interchangeable Recitations.}$$

2. The number of interchangeable stations needed for a given enrolment can be determined by dividing the number of daily interchangeable recitations by the number of daily recitation periods, or,

$$\text{Interchangeable Teacher Stations} = \frac{\text{Daily Interchangeable Recitations}}{\text{Daily Periods}}$$

or,

$$\text{Interchangeable Teacher Stations} = \frac{\frac{\text{Enrolment}}{8} + 12}{\text{Daily Periods}}$$

A school of 240 pupils operating on a six-period day would require

$$\frac{\frac{240}{8} + 12}{6} = \frac{42}{6} = 7 \text{ Interchangeable Stations.}$$

3. Due to the wide variation of class sizes in interchangeable classes, it is possible to conserve space and increase the percent of utilization of a building by varying the size of interchangeable stations. Basing a decision on structural limitations and current educational practices in class sizes, it was found best to set up three sizes of interchangeable stations, based upon 16.5 square feet per pupil station: small, or 20-pupil station rooms; medium, or 30-pupil station rooms; and large, or 40-pupil station rooms. Analysis of the daily recitation schedules of all schools gives the distribution shown in Table 2 as the optimum.

4. The optimum capacity of special stations was found to be closely related to the size of the school and the type of subject. Table 3 gives the recommended number and pupil capacity of various special rooms according to the size of the school.

TABLE 2.—DISTRIBUTION OF INTERCHANGEABLE TEACHER STATIONS, AFTER WILSON (32, 33)

Stations	Small (20-pupil)	Medium (30-pupil)	Large (40-pupil)
3	1	1	1
4	2	1	1
5	2	2	1
6	2	2	2
7	3	2	2
8	3	3	2
9	3	3	3

TABLE 3.—DISTRIBUTION OF SPECIAL STATIONS, AFTER WILSON (32, 33)

Subject	Enrolment 9–12	Teacher stations	Pupil capacities of teacher stations
Science	50–88	1	Combination room . . 30
	89–200	1	Combination room . . 35 to 40
	201–400	2	Advanced science . . 24 to 30 Elementary science . 35 to 40
Homemaking	50–145	1	16
	146–400	1	24
Vocational shop	50–145	1	16
	146–400	1	24
Vocational agriculture	50–145	2	Shop . . . . 16 Shop recitation 20
	146–400	2	Shop . . . . 24 Shop recitation 24
Typing	50–128	1	15
	129–184	1	20
	185–296	1	24
	297–400	1	28
Drawing or	50–200	None	
Art	201–400	1	28
Music Dramatics	50–400		Combination with Auditorium or Cafeteria

5. An analysis of all study-group sizes for one week in 227 high schools showed the required number of permanent study stations, as customarily provided in the study hall and library, to be as follows:

For an enrolment of 89 to 145, 1/5 of the enrolment
For an enrolment of 146 to 200, 1/4 of the enrolment
For an enrolment of 201 to 400, 1/3 of the enrolment.

Summary

Almost daily contact with superintendents, principals, and architects coming to the School Buildings and Grounds Division of the New York State Education Department for assistance in school building planning, has convinced the writer that the type of research found in that field has been of little value in setting up a room schedule for a new building.

Practically every writer in the field admits that buildings should be planned to house the educational program. With this assumption as basic, it would seem that research in school building planning, on the educational side, should start with studies of the educational program, and not with status studies of buildings *not* scientifically planned, nor with utilization studies of such buildings. A superintendent may gather together all the school building score cards, reviews of published plans, utilization studies, or school building standards now in print; but if he is faced with the necessity for providing his architect with a room schedule for a cosmopolitan high-school building to house 2,000 pupils in grades 9 to 12, such literature will be of little help to him. That type of research has been very valuable in pointing out the need for planning technics based upon a thorough knowledge of the relation of the educational program to building needs.

Wilson's study is now being extended to four-year high schools of 400 to 3,000 enrolment. Already, through the study of 212 programs of such schools, constant relationships between enrolment and the number of special and non-special classes have been discovered. These are proving of inestimable value in determining the total number of recitation rooms required for a school of given size. Further study will determine the optimum capacities of these rooms, the number and capacities of rooms of various types needed, the number of study stations necessary, etc. Data are already collected and in the process of tabulation for making similar studies for junior high schools in New York state.

CHAPTER II

Heating, Ventilation, and Sanitation in School Buildings

Heating and Ventilation

In the first cycle of the *Review of Educational Research*, the subjects of heating and ventilation were not treated in a separate chapter in the issue on school buildings, and were mentioned but briefly. The importance of the subjects, however, has led to a more extended treatment which will be covered in this chapter. The bibliography will be limited to include, with a few exceptions, material presented since 1910. This will cover, with some earlier references, the major part of the research field. As there is a bibliography record in excess of 400 titles since 1910, no effort has been made to refer to all of them; only those which seem to have a definite and major bearing upon the progress of the subjects to be discussed will be reviewed herewith.

The subjects of heating and ventilation or air conditioning, as it is now frequently called, have nearly always been discussed as a whole; this is only natural, as the two are quite intimately related—heating will always give rise to a change in air conditions, but heating alone will not produce conditions always conducive to healthful surroundings. Again, the problem of heating alone, i.e., to provide, by means of certain apparatus, certain temperatures in enclosed spaces, has been very well solved, even twenty-five years ago, through theoretical and empirical investigations. The major progress here has been in the direction of new devices and refinements of data and installations. But the problem of providing air conditioning is still in a state of flux. Therefore the greater part of this chapter will be devoted to the subject of ventilation or air conditioning. As a rule, the former term will be used for convenience and brevity.

Importance of ventilation—The effect of air and temperature upon the human body has been recognized for ages and reference to it has been an outstanding factor in virtually all literature dealing with human health. But it has been only comparatively recently that any attempt was made to explain, by various theories, the effects and influences of air conditions on the human body.

Probably the first authentic report on the effect of air conditions on the human body is that dealing with the historic tragedy of the Black Hole of Calcutta where only twenty-three of one hundred forty-six Englishmen survived the ordeal of twenty-four hours' incarceration in a room housing comfortably only two persons—an area of eighteen square inches per person (179:2). Jarvis (144:168), a physician, in commenting on the laws of health, referred to this tragedy and applied the principle of air stagnation to explain the "faintness and languor" resulting in crowded spaces. The second historical episode was that of the *Londonderry* disaster where a large group of passengers on the ship were forcibly confined in a small cabin below decks during a storm (179:2). Similar conditions to those of Calcutta prevailed and the outcome again was death to large numbers. On the other hand, Dr. Trudeau, who was afflicted with tuberculosis in 1873, isolated himself in the Adirondacks and through the fresh air treatment recovered his health. "The general value of fresh air . . . has been amply demonstrated" (179:3).

Early theories—The first milestone in the attempted analysis of the factors and conditions which influence human health through contact with the air or atmosphere was passed by Lavoisier in 1777 when he studied the effect of air in crowded quarters and attributed it to an excess of carbon dioxide rather than a lack of oxygen. A translation of his findings, according to Leblanc (153), is of interest:

> *The carbon dioxide theory*—Thus Lavoisier did not hesitate to attribute to carbonic acid the discomfort that was found in numerous assembly halls, discomfort generally attributed to heat alone; he established, by experiments made upon animals (confined) in a limited amount of air, that the effects observed were to be attributed to the . . . action of carbonic acid in quantities insufficient for asphyxiation and not to a (reduction) of the proportion of oxygen, if it did not fall below a certain limit.

This theory seemed to have been held in much esteem during the next hundred years; it was accepted with little question. In 1857 Bernard (62) reaffirmed this belief in definite terms and was quoted as stating "that the breathing process vitiates the air to the extent that it will render the air poisonous unless carried off by ventilation." Even in 1910, in a handbook for engineers by Hoffman and Raber (128:19), the statement was made that carbon dioxide is diffused through a room and makes the air unfit for breathing (210:57). Earlier textbooks of physiology and hygiene have always given undue prominence to the deleterious effects of carbon dioxide and even as late as 1910 mention is made of the poisonous gas carbon dioxide which we exhale in breathing (196). Yet Leblanc (153) in 1842 showed conclusively that a person may breathe air which contains 30 percent carbon dioxide and yet recover. "Il est un asphyxiant pas un poison."

The organic poison theory—The second milestone on the road to progress was reached by Pettenkofer in 1863. In his article, "Ueber die Respiration," he (183) stated as a kind of conclusion of his work, the following:

> What makes the air in a room filled with people obnoxious and (depressing), what affects our nerves and gives rise to symptoms (of dizziness) leading eventually to fainting, is not only the heat or humidity or the CO_2 of the air nor the depletion of oxygen—such an atmosphere appears to us as foul and nauseous long before it becomes saturated with water vapor or depleted (in a measure) of its oxygen content, or with a CO_2 content in excess of one percent. It (the air) seems to us obnoxious

> due to its having been breathed several times or as it has come into contact with the skin numerous times, as it is thus laden with organic exhalations, even in (minute) quantities.

Pettenkofer thus appreciated the problem as a whole but could not determine all of the factors involved and so he attributed much of the effect of "vitiated" air to "anthropotoxin" and "morbific" matter—body effluvia or organic poisons which gave rise to toxic effects. Thus the organic poison theory was brought into being.

Like many others the carbon dioxide theory was of the die-hard kind. Even Pettenkofer utilized the percent of carbon dioxide as an indicator. Many investigators of the next four decades after Pettenkofer's pronouncement spent a good deal of time in following up the latter's work and apparently discovered these organic poisons in exhaled air (110, 191). But the greatest adherers to this theory were Brown-Séquard and d'Arsonval. These collaborators (67) reported positively on a series of laboratory experiments and claimed to substantiate the organic poison theory. Immediately their work was challenged by Italian (202), German (192), English (108), and American (63) investigators, and all, without exception, reported negative results when repeating Brown-Séquard's experiments. Apparently the original technic was faulty.

> That an odorous, bad-smelling air, usually designated as foul, is objectionable, is of course true; but it is not the poisonous effect that is to be shunned but rather the inhibiting effect of the physiological or rather functional reaction of the human organism. This gives rise to nausea and bodily discomfort, which in turn affect the involuntary muscular system of the body and thus makes breathing labored—but there is no poisonous effect, primarily (210:58).

The situation at the end of the nineteenth century was summed up by Billings and others (63) when they stated that the investigations made up to that time provided few if any facts fundamental to our then theory and practice of ventilation.

The contact-infection theory—One result of the organic poison debacle was the growth of the contact-infection theory among medical men and others. The older air-borne infection theory (disease germs floating in air, as spreading medium) was closely allied to the organic poison theory and furnished fuel for *the contention of large air volumes as combating disease*—the ventilating angle (129). Investigations by Baskerville (51), Fluegge (99), and others have shown the fallacy of this contention and today the contact-infection theory holds sway. The effect on ventilation practices is evident.

Modern theories—Among the five changes produced by human occupancy in a closed space (164:16), three have been generally discredited as being important or having any major influence upon health: increase of carbon dioxide, decrease of oxygen, and "organic effluvia." The other changes—increased temperature and humidity—had been recognized by Pettenkofer (183), but he did not give them much importance. It was

Hermans (122) who, in 1883, when repeating Brown-Séquard's experiments, called attention to the role played by both temperature and humidity in the drama of ventilation. "The problem of ventilation in this respect (temperature and humidity) is large enough without it being necessary to drag in an accumulation of hypothetical foreign air substances. . . . It is easier to do justice to the problem if it is clearly stated what is to be accomplished through ventilation."—(Translation.) A number of investigators took up the problem which culminated in Fluegge's epochal experiment and findings (99) at Breslau in 1905. In conjunction with several of his pupils and co-workers he placed individuals in air-tight cabinets (Kasten) for several hours and found they suffered no discomfort provided the temperature and humidity were reduced to normal. The temperature was then raised to 24°C (75°F) and the relative humidity allowed to rise to 89 percent while the carbon dioxide content reached 1.2 percent. In this instance the person became "unwohl" (uncomfortable). The experiment was repeated with the modification that the person could breathe the comparatively pure air outside the cabinet. Discomfort persisted but became negligible when the inside temperature was reduced to around 62° F. A fan, stirring up the inside air, also contributed to a feeling of comfort. Fluegge (99:389) said, in conclusion:

> Numerous refined check methods and experiments, on both healthy and sick persons, with due consideration of thermal conditions, have shown that the chemical changes in the air due to gaseous emanations from humans have no deleterious effects upon their health.
>
> If, in closed rooms occupied by people, certain (functional) disturbances . . . manifest themselves, these disturbances are to be attributed (solely) to heat stagnation.
>
> The (thermic) conditions of our surrounding air—warmth, humidity, motion—are of decidedly greater importance to our health than the chemical composition of the air.—(Translation.)

This is our third milestone of progress.

These vital experiments were repeated by Benedict and Milner (58) of the United States Department of Agriculture in connection with some studies on metabolism, and their conclusions were identical with those of Fluegge. The authoritative acceptance of this theory was given by L. Hill and others (127:92), who said, in part: "Heat stagnation is therefore, the one and only cause of the discomfort. . . . The moisture, stillness, and warmth of the atmosphere are responsible for all effects and all efforts . . . should, therefore, be directed toward cooling the air . . . and the bodies of the people by setting the air in motion. . . ." This thermal theory has been the backbone of our present ventilation practice.

The whole problem has simmered down to the facts that "our thermal theory requires, among other things, air motion sufficient in quantity and low enough in temperature to dissipate the heat of metabolism at approximately the rate of its production; to remove body moisture at a rate sufficient to promote ready evaporation without actual chilling; to utilize an air velocity which will accomplish this without drafts and of a volume which will balance all of the factors with due attention to economy" (210:59). Allen and Walker (38) estimate the heat of metabolism at from 240 to 600 British thermal units with 250 British thermal units as a median for children; this means 4.2 British thermal units per minute—a very appreciable quantity. Duffield (89:65) gave similar data in tabular form and stated, "Heat losses by evaporation do not enter into the ventilation problem," but those of convection do. Taking also into account the need for a material amount of moisture to be dissipated (210:64), and we have a practical problem before us which has not yet been solved completely. The American Society of Heating and Ventilating Engineers (43:335-40) has contributed some accurate data on these factors.

Recent studies—The first extensive and practical study of school ventilation was made by the Chicago Commission on Ventilation in 1910-13 (78). A large scale experiment was carried on in the Chicago Normal College and the report carried, among many others, the following resolutions:

> *Resolved,* That the maximum temperature for a schoolroom, artificially heated, should not be more than 68° F.
>
> *Resolved,* That the relative humidity of a schoolroom, artificially heated, should not fall below 40 percent.
>
> *Resolved,* That in the present state of knowledge and practice the quantity of air supplied to schoolrooms for ventilation should not be less than 30 cubic feet per pupil per minute.
>
> *Resolved,* That in the present state of knowledge it is impossible to designate all harmful factors in or associated with expired air.

This report and also a later revision (126) has been widely quoted (77, 179), but was probably not considered either as sufficiently accurate nor extensive enough to make the findings authoritatively acceptable. Quoting from the famous New York Commission's report (179:13), we find that

> The extent and gravity of the effect upon the human body of an overheated atmosphere were still hard to estimate; and the possibility of certain subtle minor influences of chemical vitiation could by no means be excluded. It seemed important therefore to attack the whole problem *de novo,* since it was obviously impossible to make an intelligent appraisal . . . without a clear idea of the exact physiological criteria by which ventilation should be judged.

It might be said here that the "chemical vitiation" factor has not been considered proved or of any real significance. "The chemical constituents of the stale air of an unventilated room, vitiated by human occupancy, exert no detectable influence upon a wide series of physiological reactions" (179:86).

The New York State Commission on Ventilation (179) was appointed by the governor of the state of New York in 1913 and had been in existence and functioning until its final report in June, 1931 (178). Its major work was presented in a large and extensive report in 1923. In 1926 the Commission was reconstituted and again supported by the Milbank Memorial Fund.

Its findings and conclusions were in some instances rather revolutionary and gave rise to much discussion. As these conclusions are fundamental and accepted by many, they are briefly summarized from the final contribution of the Commission (178:16-22):

1. The conclusion of Hermans, Fluegge, Hill, and Benedict—that overheating is the primary factor in bad ventilation—was confirmed.
2. With certain thermal conditions the presence of chemical vitiation, with CO_2 content up to 66:10,000 produced a slight effect upon physical work and appetite, but no other reaction.
3. Overheating produced marked physiological changes.
4. High moisture content aggravated the effect of high temperature, but low humidities "had no perceptible influences and could not be subjectively detected by the subjects exposed to them."

The practical schoolroom studies brought out the facts that:

1. The ventilation of schoolrooms by windows alone was highly unsatisfactory.
2. A system of window gravity ventilation with air admitted over slanting window boards and tempered by radiation with gravity exhaust ducts proved highly satisfactory.
3. The conditions necessary for successful use of this system were stated essentially as follows: (Here follow six rather important conditions).
4. As to humidity, "the unhumidified rooms were much more agreeable."
5. Recirculation of schoolroom air (washed) had no harmful effects but it was found difficult to avoid objectionable odors.
6. The choice of systems appears to be between a plenum system and window ventilation.
7. The "atmosphere of the window-gravity rooms was more agreeable than that of the plenum rooms." (A subjective judgment.)
8. "Absences due to respiratory illness were slightly greater and respiratory illnesses among pupils in attendance were markedly greater in the plenum rooms."

The report led to much discussion and debate and some of the findings were attacked vigorously. Ittner (141) showed that there was no economy involved in window ventilation and that other factors operated in a derogatory manner. Schmidt (209) commented in a similar manner while Duffield (87) entered objections to certain phases of a check experiment by Butsch (68). In a like vein E. V. Hill (125) and Challman (75) discussed the ventilation "controversy." Berestneff (60) reported a test of six systems with the mechanical ventilation most effective. On the other hand Winslow (239), who was chairman of the New York Commission on Ventilation, vigorously defended the conclusions in all respects; similarly the American Medical Association (232) went on record favoring window ventilation in particular. An article in the *Sheet Metal Worker* (45) gave "a wind-activated system" full credit for satisfactory operation. Butsch (68), in reviewing the results of the experiments of the New York Commission in Maywood, Oak Park, and Forest Park, Illinois, came to the conclusion that window ventilation was more healthful than mechanical ventilation, using absence due to respiratory diseases as a criterion. But again Duffield (88:15), who, by the way, was executive secretary and director of the field studies of the New York Commission, opposed the findings as at all conclusive or scientific in the following brief statement:

> There is . . . evidence that the attitude of those members of the Commission who were interested in this phase of the work, had changed from one of pure research to that of the propagandist, who searches for facts to support his thesis and generally ignores all others. . . . Certain members had evidently become converted to the "fresh air" theories and they ignored evidences that did not tend to support those theories.

As the criterion of respiratory diseases has been used quite consistently it is of interest to note the validity of it in the various studies made. Duffield already has criticized it. Winslow and others (241:198) stated: "The criterion of respiratory disease illness among pupils in attendance at school is dependent upon a highly subjective factor of judgment on the part of the observer. Such observations in the absence of better objective standards than we now possess are of limited value if made by a different individual in each school." This observation is repeated in another study by the same authors (240:241). But at the same time they used the same criterion, "balanced," in coming to this conclusion:

"A comparison of schoolrooms ventilated with unit ventilators (fan units) and of those ventilated by window inlets with gravity exhaust shows that the simpler gravity process is quite as satisfactory from the health standpoint as is the system involving the use of fans." The whole matter of window versus fan ventilation was set forth in the New York Commission's report in great detail.

The controversy involved is not yet settled, and was to be determined by a control experiment in Rochester, New York, but funds were lacking and no agreement was reached on the research personnel.

Methods and air supply—The three fundamentals of ventilation—temperature, humidity, and air movement—have been accepted universally and efforts have been made to devise apparatus which would achieve these conditions efficiently and economically. The manner of distributing air in schoolrooms up to about 1918 was either by a blast system (central fan or plenum) or by gravity, while heat losses and tempering of the air were taken care of by either a furnace (hot air) or boiler (steam).

About 1918 there came upon the market the unit heater which was originally developed by the Herman Nelson Corporation (120) of Moline, Illinois. It is a self-contained, steam heated unit, with a fan (blast) and is located in each room to be ventilated; it has a direct outside air inlet. In its wake there followed other ventilators of a similar type. They found much favor among those interested, as they had certain claimed advantages over the more commonly found central systems, such as the fact that "no ducts are required except small vents. . . . It is flexible. . . . It is also supposed to diffuse the air quickly. . . ." (210:64).

Around this same time, 1918, the matter of the amount of air per pupil required, especially "fresh air," came to the fore. The "30-feet-per-minute-per-child" standard was developed quite early by Pettenkofer and others, and was based on a formula to prevent the air from having a carbon dioxide content in excess of 6 parts in 10,000 (239:91); the discarded carbon dioxide theory was still basic. On the other hand experiments by Bass (53) showed satisfactory results with an air volume of only 8.9 cubic feet, "supplied through special ducts near the face of each pupil." Similarly he (54) recommended 100 percent recirculation with ozone. The New York Commission on Ventilation (179:528) and McLure (164:23) reported that "no evidence based on scientific research has been found during this investigation to justify the standard for classrooms of 30 cubic feet of air per minute per pupil." Berestneff (60) reported investigations which recommended 9 to 15 cubic feet of "fresh air" and velocities between 100 and 200 feet per minute, much lower than found in American practice. Nesbitt (175) claimed 27.5 cubic feet per minute per pupil for high schools and 23 cubic feet for elementary schools.

Larson's study (152) on recirculated and washed air was a rather extended one and led him to some pertinent conclusions from which are quoted the following: "The tests showed that it is both unnecessary and uneconomical to supply large volumes of air to obtain good ventilation." He also stated "that 15 cubic feet [per minute] per student would be ample providing it enters the room at a fairly high velocity and carries the proper amount of moisture." As to temperature he said that with humidity ranging from 50 to 70 percent occupants of rooms are perfectly comfortable at a temperature of 65 degrees or even less. He also felt that "ventilation by recirculation is both efficient and economical." The American Society of Heating and Ventilating Engineers (44) recommended an air volume of 30 cubic feet per minute with 10 cubic feet of outside air, among other things.

Winslow (239:109) called attention to the fact that "the diminished aeration seems to be unobjectionable," this statement based upon the fact "that the air change (in window ventilation) . . . falls materially below the 30 cubic feet." On the other hand he (239:95) said: "Under certain conditions the standard of 30 cubic feet per minute may very well represent the true needs of the situation"; he (239:96, 97) referred also to the fact that "in an interior auditorium, however, it is clear that an air supply of at least 30 cubic feet per capita per minute will be urgently required," and that "a system may be entirely adequate which supplies 10 cubic feet per minute if the temperature be properly regulated." So far there has been no pronouncement as to what is actually required in the way of air supply.

Then we have Redway (193:36) who, speaking of fallacies of mechanical ventilation, said, that it "assumes that air in classrooms is thoroughly impure and vitiated, but if the air is moving all the badness is taken out of it. A more idiotic notion could not be conceived." In a semi-editorial way an article stated that 30 cubic feet per minute (fresh or recirculated) air is too much; "only when the outdoor temperature reaches 55 deg. F. will 30 cubic feet of fresh air per minute be required to keep the temperature . . . from exceeding 66 deg. Fahr." (133:128). Schmidt (210:64-65) summed up this situation, in part, as follows:

> It goes without question that the cost of operation is a big differential depending whether 10 c.f.p.m. or 30 c.f.p.m. per person are involved. . . . We have both extremes present. . . . One side claims . . . no particular inlet for outside air is required; that air movement is the only essential and that infiltration will supply all that is needed for diffusion purposes. . . . On the other hand we have the fresh-air minded who claim that even 30 c.f.p.m. . . . is none too much and that the more we get, the better. . . . Between the two extremes there is of course a reasonable middle ground. We *do* know that 30 c.f.p.m. . . . is not an actual necessity; and there are quite a number of unbiased minds who would reduce this to a much smaller amount. . . .

Strayer and Engelhardt (219) also gave an overview of the whole problem. Schmidt (206:59), basing his statement on years of field investigations, said that "results in practice . . . lead me to the conclusion that a much smaller supply of air . . . than required by law . . . is sufficient."

Since about 1929 the term "air conditioning" has been frequently used and in some of the technical literature has displaced the term "ventilation." E. V. Hill (123:7) said: "We like to define air conditioning as the science of modifying and *controlling* the air in buildings, so as to make it in the highest degree suitable for the use of mankind. Naturally this includes heating, cooling, cleaning, humidifying and all the other various processes necessary to make air suitable in the highest degree for normal human body requirements."

The factor of cooling and the fact that apparently no definite *amount* of outside (fresh) air is necessary has been seized upon and used in the form of a unit ventilator which employs the theory of "thermal balance" to provide air conditioning in schoolrooms (121). The problem was worked out uniquely in that the outside air is used as a cooling medium; when the temperature reaches a predetermined point the unit admits outside air for the time and in a quantity sufficient to maintain the temperature desired. It will be appreciated that the unit operates its fan continuously, thus providing the desirable air motion or "turbulence," but introduces variable amounts of outside air. A critical study of an installation was made by Schmidt (211:29) who stated "that the system produces good air conditions and operates in a satisfactory manner." The system of course violates many state codes and preconceived notions. At the same time it is in substantial accord with modern thought and trend.

At about the same time Nesbitt (175) reported the result of applying a similar principle to an installation of unit ventilators where he showed satisfactory results with variable quantities of outside air. The difference between the two principles lies in the fact that the Nelson theory uses variable amounts of outside air, tempered by recirculated air, for cooling, using auxiliary radiation as may be required; the Nesbitt scheme tempers the incoming air to a constant 60 degree temperature within the unit itself, relying upon this air to cool the air—on the theory that temperature differences between incoming and room air in excess of 10 degrees produce drafts. "Syncretized" air is the name applied to this principle (176).

Scherer (203:51) did some experimental work which combines unit ventilation with window ventilation; this combination had the advantage that "the flexibility of control takes care of ventilation under all weather conditions." But "the open window ventilation should not be used at the same time the mechanical ventilation is in operation. . . ."

At present the practical results of air conditioning are based in a great measure upon the criterion of the "comfort chart" developed and sponsored by the American Society of Heating and Ventilating Engineers (43: 323) which shows the relation between dry and wet bulb temperatures as lying in the "comfort zone." In contrast to this scientifically prepared criterion we have Watt's attitude (236), who spoke of the "American dry rot" and "steam heated women" and gave a final statement that "no ventilating system is good when the persons subjected to it do not like it," based on subjective judgments.

McConnell and others (161) showed that the influence of temperature and humidity may be readily determined in an objective manner by charting both pulse rate and systolic heart pressure and "the effective temperature is the only true index of physiological reaction and comfort." The reliability of the dry bulb temperature is thus questioned, at least in the above respect.

A study by Houghten and Yagloglou (132), very complete and analytical, showed the effect on various classes of individuals of different temperatures and humidities. Apparently quite low temperatures and high humidities are within the range of the comfort zone.

The open window controversy is still *en règle* and it is not likely that it will be settled either one way or another soon. One large school in Hartford, Connecticut, is equipped for this type of ventilating and appeared to be "fairly satisfactory" according to a personal report (to the writer) but, "it needs careful attention." On the other hand, C. A. Eddy (90) reported on an experiment in Detroit in which the results have been "disappointing." Respiratory diseases, the main health indicator, increased and on complaint of the teachers the experiment was discontinued. The American Society of Heating and Ventilating Engineers (81:104) made a plea for air conditioning based on health and not economy and restated that children in "open air schools" are far healthier "than those housed in the best buildings having modern systems of ventilation." E. V. Hill (124) again said, "The best in ventilation is unattainable without mechanical devices," and Butsch (69:133) admitted that "under the conditions of the present study there was no significant difference between the percentage of absence due to respiratory diseases in rooms operated on an approved type of fan-gravity ventilation and that in rooms operated on an unsatisfactory type of window-gravity ventilation." So for the time being, the matter must rest until authoritative data are produced.

Ozone in ventilation—One can hardly leave the subject of ventilation without at least touching upon ozone as a factor.

Probably no school system in the country has used ozone to the extent that it has been used in St. Louis. Hallett (109:50) stated that "ozone destroys all odors resulting from respiration, bodies, clothing of children. It produces mild exhilaration resembling sea breezes. . . . It reduces weight in persons corpulent from non-activity." Recirculated air is treated with "new" air and ozone. Robb (198) also approved of ozone as a vitalizing factor, but warned against undue concentration. Keiser (146:51) made a plea for using ozone on the basis of economy, claiming 37.5 percent fuel reduction by recirculating 50 percent of ozonized air. Hartman (115), Milligan (170), and Franklin (101) also mentioned and spoke for it, with, however, certain debatable factors involved.

On the other hand the New York Commission (179:503) stated that "the ozone appeared to give no relief from odor and in fact seemed to make things worse by superposing the odor of ozone upon the body odors." The *Guide* of the American Society of Heating and Ventilating Engineers (43:333) reported in a similar vein, "The value of ozone in recirculated air has been greatly exaggerated in the past . . . ozone in concentration permissible in air conditioning work exerts practically no effect on pathogenic air-borne organisms and does not destroy the source of odors. Ozone, however, masks odors by olfactory compensation." And finally we find Feldman (97) who gave positive evidence that body odors are destroyed. He intimated that the ozonizing of the air produces ionization which might be responsible for the effect. He also approved 100 percent recirculation with ozonizing and washing. Rosenow's study (200) on partially sterilizing air is of interest.

Sanitary Conveniences

Hand-washing facilities—This feature of a national health program did not receive much attention at the hands of investigators until the latter part of the 'twenties, though some slight reference to the matter had been made by Pleins (186) in 1910, who gave some standards of installation for lavatories. It was left to Thomas (226) to study the plumbing needs of schools and to give criteria for determining standards. At about the same time the School Health Bureau of the Metropolitan Life Insurance Company, under the direction of Turner (228), made a special study of hand-washing facilities in schools. The study was made in 404 schools mainly by the questionnaire method. The results were tabulated in a factual manner, but no particular criteria were either set up or applied except in the section on "extent of hand-washing facilities," in which case 72.6 percent, 35.5 percent, and 10.5 percent of the schools reporting met the standards of the American Child Health Association (41), the Massachusetts Institute of Technology (167), and Wood and Rowell (246), respectively. Evidently the *use* of the equipment is another matter, for "meanwhile it is a matter of administrative responsibility to use the present equipment to best advantage" (228:14). The report recommended additional problems to be the basis of further research.

Schmidt (207), in 1929, made a functional study of sanitary conveniences in Wisconsin schools, including hand-washing. He found that girls used the lavatories somewhat more frequently than boys, but also found the number of fixtures much below that required and advocated by others, even being below that of the American Child Health Association of 1:80. The lack of functioning was also well expressed by one superintendent, who said, "Well! I had no idea that our children were not carrying out the principles and dictates of our teaching. I had better look into this" (207:164). The writer (207:56) also stated, "The use of lavatories is often restricted by an undue use of mirrors suspended above them. A replacement of mirrors elsewhere will 'release' a lavatory for legitimate use," and "The absence of soap and paper towels nearly always restricts the use of lavatories." He recommended one lavatory for every two toilet fixtures.

Turner's study (228:14) resulted in an investigation along recommended lines by the Cleanliness Institute (79) in 1931; the work covered 145 schools in fifteen states. The study disclosed conditions similar and equal to those found by Schmidt (207). It also gave some interesting data on soap and water consumption, showing extremely large variations in both. The study emphasized the importance of the views of the administrator in these respects.

Tappan (225) again emphasized the necessity for personal cleanliness and called attention to the non-use of even the inadequate equipment furnished. The necessity for keeping this type of equipment in a sanitary and useful condition was stressed by numerous writers such as Dresslar (85), Garber (106), Broady, Ireland, and Miller (65), Engelhardt, Reeves, and Womrath (94), and the Metropolitan Life Insurance Company (169).

Strayer and Engelhardt (220) gave the number of lavatories as one for every fifty pupils, as a standard, while Schmidt (207) recommended one lavatory for every two toilet fixtures in each toilet room.

Standards for lavatory heights were determined by Thomas (226) by using Bean's anthropological tables (55) as a basis, thus giving a range from eighteen inches for kindergarten to thirty-one inches for high-school students.

Toilets—There is a dearth of material on "standards," which term here refers to the number of various kinds of fixtures based on actual or functional studies. Dresslar (85:67) recommended one urinal for each thirty boys, "especially if teachers and principals will so order recesses that there will be no congestion." For primary grades he recommended one urinal for each twenty-five boys. As to toilets, one for each twenty girls in the lower grades and one for each twenty-five girls in high school. However, "these numbers are reductions from the writer's earlier estimates." Schmidt (207), on the other hand, increased the number of urinals on the basis of their ratio to closets, being 5:3 and 2:1 for high and elementary schools, respectively. These figures were based on functional studies and peak loads, the latter being "corrected" on the basis of time studies. Very similar figures were given by Strayer and Engelhardt (220, 221), while Gerhard's (107:149) are very close to those of Schmidt. Alt (39:44) gave the number of fixtures as a function of total enrolment, based, however, on only a few school reports. Virtually all investigators called for various heights of closet bowls and seats, depending on the age of the pupils—as a rule "adult" sizes are used—and found that "it is positively insanitary and unjust to require little folks to use adult sizes" (85:67). Schmidt (207) also went into the physiological reasons for using proper heights of seats and recommended heights ranging from nine to fourteen inches. Thomas (226) gave very similar figures.

Interestingly enough, Thomas' study (226:118) referred mostly to urinals of the trough or suspended type; these types are either not mentioned at all or minimized by other writers—the floor type is considered modern, satisfactory, and standard for school use. Thomas (226:120) differed from Schmidt in the number of fixtures recommended; he used a sliding scale based on consensus of opinion and empirical data. Ireland (140) made a study of sanitation which is, in a measure, an extension of Thomas'.

Consensus of opinion favors toilet rooms to be located on classroom floors where "sunlight during the day is essential." Dresslar (85) emphasized good lighting and ventilation as well as Alt (39), who denied that these are obtainable in basement locations. All authors stress the need for good ventilation, but all are by no means in agreement as to specific methods. Both positive pressure and exhaust methods are in vogue.

Drinking fountains—Drinking fountains of a "sanitary" type are recommended by all writers. Thomas (226:82) favored the stream type and showed "that a larger portion of the fountains (other than stream) were infected with streptococci, which it is reasonable to assume came from the mouths of consumers." Interestingly enough, he stated that "according to the criterion used in this study it cannot be said that the fountain is superior to the individual drinking cup. If reasonable provisions can be made to assure an adequate supply of cups at all times, probably that method is to be preferred." No other mention of this fact was to be found except that the individual paper cup is mentioned from time to time as a substitute for the drinking fountain.

As to the number of fountains, there is not much dissension among investigators. The usual range is one fountain for from 75 to 100 pupils.

Swimming pools—The literature on this subject, at least that which is pertinent to school situations, is not extensive. Standards are discussed by the plumbers' trade journal (223) and the health department of California (70), the latter being quite specific from the health angle. Crane (83) and Kocher and Davison (149) gave construction data, while Mackey (163) contrasted the modern with the old. Purification was treated very fully in a series of articles by Hartman (116) and by the Indiana

State Board of Health (194). Interesting methods of underwater lighting of pools were discussed by Scherer (205) and Beggs (57).

Lighting

Natural—The matter of lighting schoolrooms and its efficiency has been treated first from the angle of the hygienist and the ophthalmologist, and has been referred to in the older medical literature. One of the specific mentions of the relation of school planning to eye hygiene was made in Cohen's book on *Die Hygienie des Auges,* where reference was made to the importance of fenestration, though no particular recommendations were evident. Posey (187) treated the subject in a similar way but recommended unilateral lighting with a window area of one-fifth of the floor area and a "maximum hygienic value of 2½ foot candles." Merrill and Oaks (168) gave a good treatise on vision and recommended good lighting. Shawan (215), in his paper on conservation of vision, called attention to the strategic position of desks and windows but made no recommendation as to unilateral lighting, "due to study which shows no real trends." Jackson (143:314), in a similar study, favored unilateral lighting but permitted some lighting from the rear, and limited the width of classrooms. "Ideal is diffuse sky light," a statement which is not subscribed to in the literature except for exceptional cases, i.e., art rooms. "Excellent illumination can be secured . . . if only the impression of having light come from above is properly applied." He also advocated placing of windows six to seven feet above the floor and close to ceiling—on both sides of a room. Challman (76), Berkowitz (61), and others were all committed to unilateral lighting. A study by Ives (142) showed that out of thirty-nine states having regulations governing window lighting, thirty-one specified unilateral window arrangement, and fourteen also permitted some lighting from the rear. A study in the *London Times* (71) called attention to the physiological effects of good lighting (and heating and ventilation).

The amount of fenestration is usually defined as a function of the classroom floor area. It varies from one-seventh to one-fourth of the floor area. Ives (142) reported a preponderance of opinion in favor of a ratio of 1:5. Martin (166) argued for a ratio of 1:4 to 1:5, but called attention to the architectural difficulties in providing this large amount of window area. Scherer (204) argued for adequate lighting on physiological grounds but was satisfied with a ratio of 1:6 due to experience with lighting codes. M. E. Smith (216) gave an appraisal and checklist for lighting.

The effect of window placement and mullion widths was studied by Bishop (64) and he concluded that wide mullions influenced the amount of light materially, reducing it to 65 percent of normal, in front of a mullion, but in no case did the illumination fall below an acceptable minimum. On the other hand, Hamon and Taylor (111:44) stated, "This study (on horizontal window spacing) forces the writers to the conclusion that we can secure just as good distribution of light by abandoning the 'standard' battery arrangement of windows" and "that the distribution factor is in harmony with flexibility." Bishop used a standard classroom while Hamon and Taylor used a one-eighth scale model for experimental purposes. In a like vein Martin (166) called attention to obstructing piers and mullions, but felt that there were no real data available in this respect. Hopkinson (130) showed that window spacing is not a serious matter. Virtually all writers called attention to the effectiveness of a large "sky angle" and the positive effectiveness of the upper half of the windows; Hopkinson made special mention of it, while Jackson (143) called for shades on the lower sash rather than the upper as a means of light regulation.

Beal and Clark (229) made a monumental study of the influence of natural illumination in schoolrooms; their conclusions were quite technical, but showed large illumination variations on pupils' desks. Dresslar and Southerland (86:10-11) made a study of classroom orientation, using a one-twelfth scale model. They found on the basis of "interference with direct sunlight on desk tops," the orientations in the order of least interference are: NE, W, E, SW, SE, S. But the writers stated that in a great measure a room needs to be flooded with sunshine "to meet the demands of safe sanitation." Thus, "without going into further detail, we are completely justified in concluding . . . other things being equal, the order of preference of orientation is W, E, SW, SE, S."

The effect of the color of the decorations as well as glare are stressed a good deal; Powell and Bell (189), Berkowitz (61), and in particular Harrison and Anderson (112) called attention to this feature and the latter writers gave the reflection coefficients of thirty-two colors. Pennsylvania (181) and Wisconsin (242) publish "approved" color charts which have been scientifically tested. The School Lighting Code (137) also gave much data on this point, while Gamble's study (105) contributed to this phase of the subject.

The standards of the intensity of illumination in terms of foot candles have been investigated for years. Horstmann and Tousley (131) gave schoolroom standards as two- to three-foot candles. Luckiesh (160) gave similar figures and the whole matter was crystallized through the publication of the School Lighting Code of the Illuminating Engineering Society (195). This was adopted by Wisconsin as a part of the state's lighting code (243) and used by Pennsylvania as well. In 1924 the code was revised as sponsored by the Illuminating Engineering Society and the American Institute of Architects (137). Its final form was approved in 1932 (139). The code raised the illumination factors materially and required five-foot candles as a minimum for classrooms and recommended ten-foot candles. The code was generally accepted and was published by the United States Department of Labor (138). The Eyesight Conservation Council of America (42) also adopted this code as fundamental and published some practical ideas in connection therewith.

Freeman (102:350) reported a study in 1919 on the effect of light intensities on legibility and the speed of reading. Apparently diminishing returns are set up around three-foot candles for speed and two-foot candles for legibility. "As far as they go they indicate that the standards of the Illuminating Engineering Society are higher than necessary in the case of older children and adults." Scherer (204) also recommended a downward revision on the basis of greater experience with the 1918 code. Like Freeman, Albert (37) called attention to the relation of light and scholarship.

The National Society for the Prevention of Blindness (245) has published a report of a joint committee on health problems in education which gives a good summary of the problems of health, vision, and lighting. One of the recommendations made in connection with throwing the responsibility of health onto the school is as follows: "The school should provide a proper environment to promote eye health, such as adequate natural and artificial light, approved shades, light colored walls and ceiling, etc." (245:53). A report by Henderson and Lowell (119) gave up-to-date ideas on this subject.

Artificial—The development of artificial lighting of school buildings has kept pace with that of natural lighting and has been fostered by private and commercial interests as well as by national societies on the basis of scientific data provided by the physiologists, medical profession, and scientists. The Illuminating Engineering Society has contributed much pertinent material.

Knight and Jackson (148) carried on a statistical study of types of school lighting, showing the importance of distribution, avoidance of glare, etc.; indirect lighting was given a high rating. Ferree (98) discussed the effect of different systems on the eye, while Spaulding and Palmer (218) went into the matter of the efficiency of various kinds of lighting fixtures. The School Lighting Code (137) utilized most of its material in the direction of artificial lighting and gave quite specific and practical data in connection with determining the size and distribution of fixtures. Luckiesh (160) and others (92) treated the topic similarly. The National Lamp Works (174) showed the importance of good artificial lighting based on physiological considerations. In opposition (in part, at least) to Freeman (102), this booklet showed that a higher degree of illumination than usually found was beneficial as regards "perception, discrimination, fatigue, etc." A series of curves illustrated the claims made. The National Lamp Works (173) has compiled an excellent glossary of illuminating terms. A similar one will be found in the transactions of the Illuminating Engineering Society (136).

Pilkey (185:41) called attention to the importance of scientific data as a basis for providing artificial lighting in schoolrooms. "Artificial lighting is not a matter of hanging bare incandescent lamps haphazardly about the room." The writer recommended twelve- to six-foot candles of illumination for classrooms. Powell (188:43) argued for adequate illumination and color decorations in keeping with the principles of the illuminating art. ". . . It has been proved beyond doubt that adequate illumination does affect acuity . . . and that . . . it is quite possible to secure illumination which is adequate, proper and at the same time artistic." Bennett and Maloney (59) gave some convincing illustrations on the effect of color, etc. on the intensity of illumination. Sturrock (222) made a plea for higher intensity of illumination and showed the beneficial effects of raising the intensity from three- to twelve-foot candles and cited at length Atwater's paper (47) on a like matter. The special committee of the Society of Illuminating Engineers (46) recommended five-foot candles and special precautions against glare. They also recommended special lighting for libraries, as did MacDonald (162). Atwater's treatise (48) on windowless schools gave a new and modern slant on this subject.

With the newer developments of the older selenium cells, the photoelectric cell or eye has come into its application to schoolroom lighting and control. Advocated by the electrical interests and taken up by schoolmen it is gaining favor. Frostic (103:50) reported an installation in Wyandotte, Michigan, such that two control rooms and one corridor master cell control the switching of the artificial lighting units, thus keeping the light variation within very close limits as compared with manual control. "Contrary to general opinion, with equal window area and floor-window ratios there is less demand for artificial lighting on the north exposure, in northern latitudes at least, than for southern exposures, due to better diffusion of light."

Atwater (47:296) called attention to a similar situation in Tuscumbia, Alabama, where a control experiment in automatic light control (photoelectric cell) has been in progress for three years. "The children in room I (automatic control) were much more alert, cheerful, and attentive, while those in room II (manual control) seemed restless and sleepy on dark days and were harder to teach."

Of late years the therapeutic effects of natural lighting have received considerable attention and there seems to be a difference of opinion regarding the use and effectiveness of special glass transmitting ultra-violet rays. Keller (147) gave a good deal of credit to ultra-violet ray transmitting glass in promoting nutrition and general health. W. H. Eddy (91) reported similarly that the glass transmitted sufficient rays to prevent rickets, provided the rays were direct and exposure lengthy. Oday and Porter (180) favored ultra-violet sources of light for general illumination. The *American School Board Journal* gave a résumé (93) of a number of school experiments to show a gain in health and a better scholarship rating for pupils exposed to ultra-violet glass. On the other hand an article (213) in *Survey* showed that there was no advantage as regarded general health scores of children exposed to ultra-violet light.

Stage lighting was given extensive treatment by Fuchs (104), while Carey (72) referred specifically to schools. Selden and Sellman (214) also gave pertinent material to the subject in connection with scenery production. Permaflex has issued a bulletin giving practical ideas on the use of reflectors for stage work (49).

Recommendations

It will appear from the foregoing summaries that many problems need solution. Among these are:

1. What percent of outside (primary) air is *really necessary* under ordinary conditions?
2. What is the number of air changes that are *needed* in a schoolroom and what air motion is essential?
3. What are the characteristics of window ventilation, and what are their relations to those of a mechanical system?
4. Exact data on the performance of various systems of ventilation under control conditions and in relation to each other.
5. The development of generally accepted criteria to be used in these investigations.
6. Accurate data as to the effectiveness of ozone in connection with air conditioning.
7. The effect, physiological and psychological, of recirculated air in varying proportions.
8. More empirical data on the necessary number of toilet fixtures under differing types of school organization.
9. Control experiments with acceptable criteria for determining the required intensity of schoolroom artificial lighting, possibly based on physiological factors.
10. Empirical data of the effect of different horizontal window arrangements in actual practice.
11. A record, possibly automatic, of the variation of daylight intensities for continuous periods in classrooms, as a basis for determining window areas for different sections of the country. (A "prediction" formula may be developed in this connection.) This would be an extension of Beal's study (229).
12. Accurate data on the effectiveness (and train of consequences, if any) of unilateral versus bilateral (two sides or one side and rear) schoolroom lighting.

CHAPTER III

Equipment, Apparatus, and Supplies

THIS CHAPTER REPORTS certain trends in the field of school equipment and supplies as revealed by professional writings published between July, 1932 and January, 1935.

The *Review of Educational Research* for December, 1932 defined school equipment and supplies as those commodities which contribute directly or indirectly to the work of instruction. Although supplies and equipment are sometimes confused, they may be differentiated by the fact that supplies are consumed by use during the year, whereas equipment is expected to be used over and over again year after year. It is commonly accepted that satisfactory supplies and equipment contribute significantly to the successful operation and maintenance of a school at modern standards.

The 1931 budgets of many school districts were the largest in their history. Since then, however, practically every school system has found it necessary to reduce expenditures. Even schools that felt they were operating on a minimum expenditure per pupil have been forced to find still stricter means of economy. During the past three years, the predominating note expressed in professional writings about equipment and supplies has been economy in the use and conservation of materials, and the application of efficient business principles to their selection and purchase.

Undoubtedly, there is a wide variety of policies and practices followed by boards of education throughout the country in the expenditure of appropriations for educational equipment and supplies. If a change to a better policy will permit the purchase of the same quality of materials at a lower cost, desirable economies can be effected. Basic policies to accomplish this have been outlined by Cline (267), Collins (269), Frostic (281), Hibbert (302), Nash (323), O'Dell (333), Richardson (342), Shreve (345), Ullrich (357), and others (304). These writers have advocated definite standards and specifications to meet the needs of the changing trends in administrative practices. Adoption of standards and specifications for the purchase of equipment and supplies is a means of measuring the proposals made by various bidders. Such standards are considered fair to the bidders. They tend to eliminate inferior products that so often prove costly in the end, and they are a distinct help and service to boards of education.

Since the cheapest products often prove to be the most expensive, particular care should be taken at times when appropriations are low, in selecting the best quality available for the amount of money to be spent. Selecting the bidder and measuring the quality of the products submitted to the school were discussed by Bennett (253), Bruce (260), Cheney (265), Cocking (268), Jones (309), McClinton (316), Miller (320), and others (261, 319, 325). Reducing the cost of school equipment and supplies by quantity and cooperative buying was treated by Lex (311), Morris (321), Young (362), and others (344). In communities where the local governments are so constituted as to permit it, a central purchasing bureau may be the means of reducing costs by cooperative and quantity purchases.

Methods of control of equipment and supplies, particularly regarding storing, distributing, maintaining, and accounting for school materials, were discussed by Bible (256), Chambers (263), Clark (266), Frostic (284), and others (338). Even the best organized school systems have openings for minor wastes, for which these authors suggested remedies.

There is a large number of specific items in the field of school equipment and supplies which are of special rather than general interest.

The effect of the National Industrial Recovery Act on school supplies and equipment was described by Brodinsky (258).

Checklists, specifications, and inventories were rather widely discussed. Eleven particularly instructive references were found (254, 255, 264, 301, 306, 339, 343, 348, 353, 354, 361). Definite specifications and the use of checklists were found to be a distinct economy in the selection and purchase of school equipment.

There were many reports on new room layouts and equipment lists for special rooms. Shop room layouts predominated. Eleven studies well worth consultation were made by Brandt (257), Brodshaug (259), Calhoun (262), Coté (270), Hamon and Standish (288), Patterson (336), Resides (341), Stahl (350), Taylor (353), and Wagner (359).

The popularity of visual education and sound amplifying apparatus in the schools appears to be increasing. Seven references on these subjects were noted (272, 273, 298, 299, 310, 347, 356).

References to safety and health devices were frequent, such as those by Armstrong (251), Frostic (282), Hart (289, 290, 291, 293, 295, 296), Homan (303), Nelson (326), and others (328). Lockers, fire alarms, cleaning devices, laundries, adjustable seats, and heat control instruments were discussed in relation to health and safety.

The proper lighting, the control of light, and the conservation of sight were discussed by Ferree and Rand (275), Frostic (279, 280), Sturrock (351), and others (327, 330).

Innovations in equipment including benches, blackboards, chairs, and office machines were reviewed by Hart (292, 297, 300), Hughes (305), and others (252, 274, 307, 308, 314, 318).

Scattered references were reported on many items for the improvement of the schools: dishwashing machines and equipment, cleaning compounds and soap dispensers, painting and decorating, sound deadening materials, locks and lockers, blackboards, musical instruments, floodlights, museum material, school buses, sanitation supplies, playground equipment, and the like. The bibliography to this chapter (Nos. 251-362) gives 112 references to school equipment and supplies published since July, 1932.

CHAPTER IV

School Playgrounds: Their Surfacing, Administration, Use, and Care

THE ACTUAL BEGINNING of the modern organized playground in America is credited by Pangburn (376) to Boston, whose sand gardens were opened in 1885 under the supervision of matrons. In 1891 playgrounds provided only about one acre of space to every 1,000 to 1,500 children. In the early years of the movement, private, voluntary effort secured and maintained playgrounds, through tag days, bazaars, and public subscriptions. By 1929, however, 84 percent of the year's expenditure of over 33½ million dollars for public recreation in the United States was tax money.

Curtis (367) in 1921 attributed the new emphasis on organized games and athletics to the influence of the war. He stated that since 1916, 28 states had passed laws putting organized games and athletics into the program of the public schools. By 1930, according to Ready (378), 37 states had enacted such laws.

Nash (370) noted four distinct stages in the development of the playground movement as follows:

> 1. The charity stage prior to 1900 when the money for the support of playgrounds was raised by private means.
>
> 2. The park stage which may be thought of roughly as the decade between 1900 and 1910. During this stage tax support came to the aid of the playground movement and the administration naturally fell to the city park departments because they had the land. Because the park did not meet the real needs, the Playground and Recreation Association of America was organized in 1906 and paved the way for the third stage between 1910 and 1920.
>
> 3. The trend during this period was toward separate recreation commissions and demand for trained supervisors. Following the World War there was a flood of legislation relative to physical education. "This was largely the basis for the fourth stage, which with the help of other social movements bids fair to bring to America the solution of this problem."
>
> 4. The school stage. With the new interpretation that is being placed on physical education, the school is able to assume the responsibility for the full out-of-school playtime of the children. With the school already in contact with all the children of the community, it is the only institution that can guarantee full play opportunities to all children.

Thus recreation and physical education with the necessary grounds and equipment have become important functions of the public schools, with the probability that boards of education will be increasingly given the responsibility for all public recreation programs.

Organization and Administration

Rogers (379), in 1924, reported a study which he had made of the organization and administration of recreation in the cities of the country. At that time, 52 of the 56 cities of over 100,000 population replying to his questionnaire stated that they had playgrounds other than those connected with the school. Forty-six cities reported municipal control of these playgrounds; 6, control by the board of education; and 2 cities, joint management by the two agencies. The administration of school playgrounds in 25 cities was under the exclusive supervision of the schools, but in 24 cities they were under the control of some other municipal agency after school hours or in the summer. Forty-seven cities were providing playgrounds for all new buildings. "Of the 39 cities venturing an opinion as to administrative control, 29 believed that the schoolboard should supervise all playgrounds of the city, 11 favored municipal supervision, and 3 thought there should be dual management—of the school playgrounds by the board of education and of the municipal grounds by municipal authorities."

Nash (370) published data showing that in 1925 the administration of municipal recreation systems in 214 cities was as follows:

Independent recreation commission	93
Schoolboards	40
Recreation bureau in park departments	28
Joint departments or commissions	21
Other city departments	8
More than one department or divided responsibility	24

The same writer (369) prepared a comprehensive discussion of the administration and supervision of physical education.

Smith (381) reported a questionnaire study of playground supervision in Arizona elementary schools. He found a large majority of the schools were providing play programs with adequate supervision. Weiland's study (382) of 134 Nebraska schools found the play program in most of the schools to consist of fifteen-minute recess periods in both morning and afternoon which were supervised by the teachers. Rowe (380) described a plan worked out in Cleveland for the selection and rating of the employed personnel of summer playgrounds by means of score cards and rating sheets.

The effectiveness of playground supervision in Los Angeles in preventing accidents is reported in the following words:

> City children are less likely to be injured while playing on a supervised playground than anywhere else. . . . In the year 1932-33 in the city of Los Angeles there were only 69 playground accidents reported, although the total attendance exceeded ten million. The principal contributing factors to these accidents were tripping, falling and collision, loss of grip on play apparatus, playing in restricted areas, unauthorized climbing, and improper use of apparatus. Careless throwing or swinging of bats, sticks, and mallets also resulted in a number of accidents (365).

Size and Location of Playgrounds

The Playground and Recreation Association of America (377) made studies in a number of large cities which showed that nearly one-half of the children attending playgrounds live within a quarter of a mile of the areas studied and that comparatively few children walk more than a half mile in order to reach a playground. They concluded that

> . . . danger from street traffic is perhaps the most important factor in determining the distance children will walk to attend a playground, and as a rule the effective radius of playgrounds in smaller communities is greater than in large cities. Experience has shown that the maximum effective radius of a children's playground is one-half mile or less and it is generally agreed that a playground should be provided within one-half mile of every home. . . . Many cities have adopted the policy of providing children's playgrounds either on their elementary-school sites or adjacent to them.

Nash (369) analyzed the space needs for both neighborhood and district playgrounds. He concluded that to accommodate a maximum of 288 players, a neighborhood playground should have 4.4 acres, and a district playground should have 7.1 acres for 242 players. This difference in size is due to the different programs recommended for neighborhood and district playgrounds.

Ready (378) found that 8 states have laws requiring that certain areas be provided for school playgrounds, while state boards of education in 20 states have made rules and regulations requiring certain areas for school sites. Areas required by law were found to vary from one to six acres, while rules and regulations of state boards of education vary for elementary schools from one to six acres and in junior and senior high schools from two to ten acres. The same study also called attention to the gradual development of standards in determining necessary play space. The Playground and Recreation Association of America (377) stated that "the minimum size for a neighborhood playfield should be ten acres . . . a twenty-acre tract is preferable."

The National Recreation Association (373) made one of the most thorough studies of space requirements for playgrounds. Table 4 (p. 367) gives a comparison of requirements for playgrounds to accommodate approximately 600, 300, and 1,000 children aged five to fifteen years.

Playground Equipment

A committee (372) of seventeen recreation executives prepared the following as minimum standards for playground equipment:

Children under six years: Chair swings,—set of six; sand box (in two sections); small slide; simple low climbing device.

Children six-twelve years and older: Swings—frame 12 feet (set of six); slide—8 feet high, 16 feet long; horizontal ladder; traveling rings or giant stride; balance beam; see-saws (set of three or four).

Optional: Horizontal bar; giant stride or traveling rings (whichever is not provided above); low climbing device.

According to the California physical education manual (375), elementary-school playgrounds should be provided with a safety climbing tree, safety platform slide, graduated horizontal bars, parazontal bars, two horizontal ladders, stationary travel rings, giant stride, junior jungle-gyms. Hungerford (368) published a description and plans of play apparatus made and used in the Preschool Laboratory of the Iowa Child Welfare Research Station. Nash (370), the National Recreation Association (372, 377), and a number of the state departments of education have published material concerning playground equipment.

TABLE 4.—PLAYGROUND STANDARDS OF THE NATIONAL RECREATION ASSOCIATION (373)

Standards	Standard	Limited	Large
Child population to be served	600	300	1,000
Apparatus area (square feet)	7,700	5,600	10,270
Child capacity of apparatus area	122	65	74
Average square feet per child served	63	86	74
Area for equipment (square feet)	21,300	13,000	30,900
Child capacity of this area	285	170	450
Average square feet per child served	75	76	69
Special areas for games and sports (square feet)	109,975	83,150	169,560
Child capacity of this area	156	118	250
Average square feet per child served	705	704	678
Total area of playground (square feet)	151,975	111,250	233,230
Total area of playground (acres)	3.49	2.55	5.35
Child capacity of total playground	563	353	859
Average square feet per child served	270	315	272
Child capacity per acre	161	138	160

Playground Surfaces

The problem of finding a means of surfacing playgrounds which will meet all requirements remains to be solved. Altenburg (363) who made a study of play facilities in 71 elementary schools in 71 cities concluded that "despite the great amount of studying that has been done on this problem, there does not seem to be any standard followed for surfacing play areas in the schools that were examined for this study . . . (and) it would seem that surfacing of playgrounds has been more or less hap-hazard." Condit (366) concluded that "no surfacing has yet been devised which is ideal or satisfactory for every ground." Different parts of play areas require different kinds of surfacing and different soils and physical conditions produce special problems. Butler (364) reported that a group at the National Recreation Congress agreed that on all children's playgrounds intensively used the year round, it is desirable that a part of the area should be surfaced with hard material, preferably of a bituminous nature and that this part should be located adjoining the building.

The Playground and Recreation Association of America (377) has given the following résumé of the methods used in various localities:

> The surfacing which has proved successful in Detroit, and which is practically identical with that recommended by the New York State Board of Education for schoolyards and playgrounds, is prepared as follows: All grass, weeds, stones, humus material or other débris are removed and a fill of clean cinders is put in. The cinders, which should not exceed 2 inches in diameter, are spread to a depth of 3 inches, wet and rolled with a suitable roller until no waves appear in front of the roller. The finished grade of this course should parallel the finished grade of the finished course. This course ought to be wet before the second course is applied.
>
> The second course consists of 3 inches of limestone screenings and dust spread evenly over the first course, rolled with a suitable roller, and wet between the rollings until a smooth compact surface is obtained.
>
> The third course consists of calcium chloride spread evenly over the entire surface, about 1½ pounds per square yard. As a fourth course, ⅛ inch of coarse, sharp sand is spread evenly over the entire surface.
>
> The special committee on surfacing of playgrounds appointed in June, 1924, to make a study of the problem, presented the following suggestions for the consideration of the Chicago Board of Education:
>
> 1. The Committee condemns the use of cinders for surfacing either on playgrounds or school grounds used for play purposes.
> 2. Future playgrounds should be crowned to drain to the side, rather than the present method of draining to the center.
> 3. In the case of playgrounds now constructed in which cinders combine or compose the major portion, the cinders should either be removed or regraded to permit not less than a 4-inch coating of yellow clay to be properly rolled and surfaced with torpedo sand. The use of yellow clay with a sticky texture is preferred.
> 4. In the case of new playgrounds to be constructed, they should be excavated, if necessary, 14 inches and filled with at least 6 inches of cinders, properly rolled and 6 inches of yellow clay, properly rolled; surfaced with torpedo sand and drained to the side. The subgrade upon which the cinders rest should be parallel to the finished grade.
> 5. All grounds should be treated at least twice a year with a solution of calcium chloride, approximately ¼ gallon to the square yard (liquid form).

In response to a request made by a group of recreation authorities that a special study be made of the problems involved in surfacing recreation areas, the National Recreation Association (374) appointed a committee of eleven recreation executives to conduct such a study. The committee limited its inquiry to such areas as were devoted primarily to children's play and to specially surfaced courts used for tennis, handball, and similar games. An effort was made to collect information concerning the various kinds of materials used for surfacing such play areas, the methods of constructing and maintaining the surfaces, and the cost involved. The report of the committee contains detailed specifications for a great number of the most satisfactory surfaces.

Wiley, in the 1932 proceedings of the National Council on Schoolhouse Construction (371), reported on the experience in playground surfacing in Milwaukee. Between 1922 and 1931, 46 playgrounds were treated or reconstructed with penetration tar macadam of various types, and 23 were treated with oil on sand, gravel, cinders, furnace slag, and other mixtures. None of these treatments was entirely satisfactory. He reported that one of the larger playground areas had been divided and equal sections treated with Kentucky rock asphalt, penetration tar macadam, emulsified asphalt, premixed tar with tar-seal coat, and premixed tar with asphalt-seal coat. From this experimental set-up it may be possible to make comparisons under identical conditions of these different kinds of playground surfacings.

CHAPTER V

Public School Plant Insurance

In the issue for December, 1932, of the *Review of Educational Research* dealing with school buildings, grounds, equipment, apparatus, and supplies, no data were presented on the problem of school plant insurance. However, since that review was prepared, boards of education, in their efforts to find means of reducing school costs without seriously affecting the school program, have given considerable attention to school plant insurance as one means. As a result of these efforts, a number of recent studies have been made in this area.

Since this problem is likewise a financial one, it was briefly presented under the general title of "Management of the School Plant" in the second cycle of the *Review* in the April, 1935, issue on finance and business administration. Because of the recent and current interest in the field of school plant insurance which, as stated above, has resulted in a number of investigations, it seems advisable to make a separate chapter in this number for such material as is available on the topic.

Present Status of School Plant Insurance Legislation

Melchior (393), in one of the pioneer investigations in the school plant insurance field in 1925, studied, among other things, the legal requirements pertaining to school insurance in each of the 48 states, Alaska, the District of Columbia, and Puerto Rico. He found that 12 had mandatory provisions for school plant insurance, 9 permissive provisions, and that 30 had no legal requirements. Werner (402), in 1935, made a similar study and found that the number of states and subdivisions with mandatory legal provisions for school plant insurance had increased from 12 to 16, those with permissive provisions had decreased from 9 to 8, and those with no legal requirements from 30 to 27. The trend, then, as evidenced by these two studies, made ten years apart, is toward mandatory requirements for school plant insurance. The states falling into each of these classifications, according to Werner, are as follows:

With mandatory provisions: Alabama, Arizona, California, Colorado, Delaware, Idaho, Maine, Montana, Nevada, New Mexico, New York, North Dakota, South Carolina, Texas, Vermont, and Wisconsin.

With permissive provisions: District of Columbia, Iowa, Kentucky, Michigan, New Hampshire, Pennsylvania, Mississippi, and Washington.

With no legal requirements: Alaska, Arkansas, Connecticut, Florida, Georgia, Illinois, Indiana, Kansas, Louisiana, Maryland, Massachusetts, Minnesota, Missouri, Nebraska, New Jersey, North Carolina, Ohio, Oklahoma, Oregon, Puerto Rico, Rhode Island, South Dakota, Tennessee, Utah, Virginia, West Virginia, and Wyoming.

State Plans for Self-Insurance

South Carolina in 1900 was the first state to set up a system of state insurance on public buildings by making provisions to write 10 percent of the fire insurance on buildings of the state institutions. This plan as it has developed was reviewed by Miller (394) in 1931 and brought down to 1934 by Holy (389). Its main provisions are:

1. All of the insurance—fire, lightning, and windstorm—on all the public buildings of the state, counties, and on public school buildings is now carried by the state. School buildings were first so insured in 1913.
2. The fund is under the control of a sinking fund committee made up of six ex-officio members, four of whom are executive and two legislative.
3. The rate charged at the beginning was essentially that of regular insurance companies with the profits resulting therefrom going into a permanent fund with the ultimate object of providing free insurance.
4. The state law provides that when this permanent fund reaches a million dollars, free insurance will be carried on all buildings in the fund for five years more, so long as the permanent fund does not fall below the limitation fixed by law.
5. This million dollar permanent fund was reached in 1926. Between that time and June 30, 1934, only one assessment, amounting to 75 percent of the regular annual premium, has been levied against the property carried on free policies by virtue of the five-year provision.
6. On June 30, 1934, out of a total of $41,204,047 of property insured by the state, $34,581,795 or 84 percent of the total was carried under these free policies.

The general provisions of the Wisconsin plan, created in 1903, and amended in 1911 and 1913 to include (but not on a mandatory basis) public school buildings, and those for North Dakota, where such a plan has been in effect since 1919, were reviewed by Holy (389). In the former state the rates charged for school buildings are 49 percent of those charged by regular stock companies doing business in the state, and in the latter the rates are approximately 75 percent of those charged by fire insurance companies operating in the state.

The general provisions of the state plans in operation in Alabama, Florida, and Michigan were given by Sensing (397). He also pointed out that Tennessee in 1905 created a fund of $75,000 to protect a few state-owned buildings. This fund, however, which in 1931 amounted to $145,413, applies to only a small number of state-owned buildings. He further pointed out that Louisiana has a law which permits the state to finance the insurance of state college buildings, but this law has not been operative.

City Plans for Self-Insurance

A comprehensive study made in 1932 by a special committee of the National Association of Public School Business Officials (395) deals in one section with self-insurance as practiced in city school districts. This study reported that "at least" 49 city school districts had at that time self-insurance plans (395: 114).

The result of the survey covering the self-insurance phase of this report, reveals a total of 49 cities, representing a total population of 22,916,937; 4,556 buildings with

> a total valuation of $1,274,729,897.30. The losses reported total $1,415,352.99. The ratio of losses to total valuation being eleven thousandths of one per cent., which unquestionably indicates that the self-insurance plan for large cities with a large number of risks well scattered is absolutely sound in theory, and has proved itself in practice.
>
> Of each dollar paid to insurance companies for premiums only approximately one-half is designed for payments of losses, the purpose of the other half being that of overhead and expense. It is most certain that school districts can conduct their own insurance for but a small fraction of fifty per cent. so that even if the school losses should run as heavy as the average for all properties (which is far from the case), there would still be a very material saving under this fifty per cent. underwriting expense item.

Among this group of 49 cities are Boston, Chicago, Cleveland, Cincinnati, Detroit, Kansas City, Milwaukee, New York, Philadelphia, San Francisco, St. Louis, and Washington, D. C.

Because the Cincinnati plan, which began in 1912, was among the first of the self-insurance plans, it is briefly reviewed here. Quoted from Holy (389) is the following relating to this plan:

> For each year from 1912 to 1924 inclusive, the Cincinnati Board of Education transferred $25,000 from the general fund to the replacement fund, which with earnings amounted to $361,000 in 1924. In 1925, the Board fixed the maximum of the fund at $350,000, so the difference, together with later income, was transferred back to the general fund. In 1928 the Board decided that the funds should be allowed to increase to $500,000. On October 19, 1934, it amounted to $450,568.
>
> A study of the expenditures made from this fund for losses to school property show that none were made between 1912 and 1928. Upon investigation it was found that no school fire occurred in Cincinnati during that period. If all the property losses paid from this fund are distributed over the 22 years during which the plan has been in operation, they amount to an average annual loss of $879. On the basis of insurance premiums paid in five other large Ohio cities, it is estimated that this plan of self-insurance has saved the Cincinnati school district, after all losses have been deducted, $204,000. No appropriation has been made to this fund since 1924.

Drake (385), in reporting for Columbus, Ohio, where there is neither school building insurance nor a replacement fund for protection, found that over a 35-year period there had been only four small school fires, representing a total loss of $13,000. On the basis of the 1927 valuations of school property in the district, he estimated that an 80 percent fire insurance coverage would cost the Board of Education approximately $30,000 a year.

Comparison of School Plant Insurance Premiums and Losses

Keith and Taggart (390) were authorized by the General Assembly of Pennsylvania to make a study of school plant insurance in the state and "present their conclusions thereon to the session of the General Assembly to be held in the year 1929." Their study covered the five-year period 1922 to 1927, and included about 25 percent of the school districts of the state, exclusive of Philadelphia and Pittsburgh. They found that the total amount of premiums paid in these districts during the five-year period was $1,071,092, and that the losses amounted to $220,976, or slightly more than 20 percent of the premiums paid. During the same period the loss ratio in Pittsburgh was 21.7 percent.

Werner (401) gave figures on the loss ratio in four states. (See Table 5.) Pennsylvania, which is included in the report, is not given here because similar figures appear above.

TABLE 5.—SCHOOL PLANT INSURANCE LOSSES IN FOUR STATES, AFTER WERNER (401)

State	Years	Total premiums	Total losses	Percent losses are of premiums
Maryland	1926, 1928, 1930, and 1931	$84,613[a]	$14,586[a]	17.2
Missouri	1927–1931	2,400,000	936,000	39.0
Texas	1931	774,629	372,501	49.2
Virginia	1925–1930	189,687[a]	145,925[a]	77.0

[a] Average annual figures.

Holy (388), in a series of studies covering all the school districts of Ohio for a four-year period, found ratios as given in Table 6.

TABLE 6.—SCHOOL PLANT INSURANCE LOSSES IN OHIO, 1930–33, AFTER HOLY (388)

Item	1930	1931	1932	1933
Fire insurance premiums paid	$514,576	$465,077	$372,369	$403,152
Fire losses	14,444[a]	47,386[a]	14,573[b]	39,562[b]
Percent loss is of premium	2.8	10.2	3.9	9.8

[a] For these two years, the losses are those from fire reported to the state fire marshal.

[b] For these two years, the figures represent actual amounts received "from insurance companies for losses to school property."

He also prepared a table showing the ratio which premiums paid for school property insurance in Ohio was of the total net premiums received by fire insurance companies for Ohio business. These percents for each of the four years were as follows:

1930	1.41 percent
1931	1.45 "
1932	1.39 "
1933	1.66 "

These low ratios of losses to premiums paid, which are based on actual reports for each school district in Ohio, as compared with the states given previously, are no doubt partly due to the large proportion of fireproof buildings in Ohio. In an unpublished survey made by the Ohio State Planning Board in 1934 it was found that 8 percent of the public school enrolment in the state was housed in frame buildings, 32 percent in buildings having "exterior of brick, stone, or reinforced concrete walls with floors and other interior construction wholly or in part of wood," and the remaining 60 percent in fireproof buildings.

In the study made by the National Association of Public School Business Officials (395), to which reference has already been made, it is found that the ratio of fire losses to premium payments on fire-resistive buildings valued at nearly $500,000,000 was 8.76 percent, while on buildings of ordinary construction, valued at nearly $400,000,000, the ratio was 41.4 percent.

The director of research for the Arizona State Department of Public Instruction (383), in a study covering the state of Arizona for the period July 1, 1932, to June 30, 1934, found the premiums paid and losses collected for buildings classified as to the type of construction shown in Table 7.

TABLE 7.—SCHOOL PLANT INSURANCE LOSSES IN ARIZONA, 1932-34 (383)

Item	Fire resistive	Ordinary construction	All types (blanket coverage)	Total
Premiums paid	$18,544	$9,397	$34,946	$62,887
Losses collected	331	16,467	21,600	38,398
Percent which losses were of premiums	1.8	175	62	61

A number of other studies showing the relation of premiums paid to losses collected have been made for individual districts, but they likewise show a relatively low ratio.

Reducing Commercial Insurance Costs

H. A. Smith (399), in a careful study entitled *Economy in Public School Fire Insurance,* stated that his main purpose in making the study was "to discover economical and, at the same time, safe methods of insuring public school buildings against fire." His findings were based largely on a questionnaire asking for the valuation of school property and the amount of fire losses suffered in all cities of more than 30,000 population in the United States. His conclusions and possible economies based on those data are listed under the following headings:

1. Economies through writing all insurance policies for a five-year term
2. Economies through the installation of automatic sprinkler systems in woodworking shops
3. Economies through having a careful appraisal of the school property and placing all insurance written under the co-insurance clause for 80 percent of the insurable value of the property
4. Economies through making minor inexpensive changes in the construction of the building, thus causing a reduction of rates
5. Economies through removing certain charges added to the rates because of faults of management
6. Economies through the installation of electric power in place of steam boilers.

He also found that the loss per $100 valuation in 65 cities was nine times as great on buildings of ordinary construction as on buildings of fire-resistive construction.

Viles (400), in an unpublished dissertation, reported a study of the effect of fire hazards on insurance costs in 516 grade- and high-school buildings selected at random in Missouri. These buildings were classified according to type of construction, and the actual or published insurance rates compared with the base rates for each group. The latter is determined by the class of the town, type of buildings, and fire-fighting facilities. To this base rate are added certain penalties resulting from such causes as structural defects and type of occupancy, to make up the actual or published rates. His findings are contained in Table 8.

TABLE 8.—COMPARATIVE INSURANCE RATES FOR 516 SCHOOL BUILDINGS IN MISSOURI, AFTER VILES (400)

Class of building	Number of buildings of each class	Average base rate per $100	Average published rate per $100
High school, fire-resistive	20	$.273	$.558
Grade school, fire-resistive	20	.224	.374
High school, brick or stone with wood interior	153	.567	1.026
Grade school, brick or stone with wood interior	289	.569	.845
High school and grade, frame	25	1.148	1.351

The summary of his study is quoted here:

> On these buildings about one-third of the average published rate is made up of penalties levied because of the fire hazards found in the building. These penalties may be divided roughly into four classes: Structural, occupancy, exposure, and aftercharges.
>
> The structural penalties are levied because of the presence of fire hazards created by the construction of the building. The heating plant, ventilating system, shop units, and the home economics department are common sources of these penalties.
>
> The aftercharge penalties are often levied because of poor housekeeping and poor maintenance methods. Defective wiring, stoves with poor protection, the lack of pilot light, insufficient stovepipe protection, broken plaster, and rubbish in the building may draw heavy penalties.
>
> The large number of these penalties may be eliminated without much cost by removing the fire hazard for which they are levied. Some of the penalties can be avoided by proper attention to construction details when the building is erected.

Linn (391) reported that in a single 34-year old building, an appraisal which cost $450 resulted in a net annual saving of $1,154 in insurance. He also reported that in the city of Muskegon, Michigan, the Board of Education, by means of reappraisal of the school buildings and contents, reduced the amount of insurance necessary for adequate protection so that an annual saving on premiums of $3,000 was effected.

Beach (384), in a study of school plant insurance at Oyster Bay, Long Island, found that with proper appraisals, elimination of certain fire hazards, and changing the policies all to five-year terms, the annual premiums were reduced by approximately 30 percent.

On the basis of a study of 150 school buildings, Holmes (387) found an average error of slightly more than 20 percent in the insurance underwriting.

Miscellaneous

There are a few references which do not fit into the other classifications, which are grouped here. Little (392) reported a contract agreement between three school trustees associations and three mutual fire insurance companies operating in three provinces in western Canada. Two conditions of the first agreement, made in 1930, were:

1. That the school rates be reduced 20 percent
2. "That any surplus of premium income available, after payment of fire losses, necessary operating expenses, and an agreed percentage for company reserves, be set aside as property of the schools insured under the plan to be used to reduce insurance premiums when policies are renewed."

The plan, which now includes about 5,000 schools, has resulted in a series of rate reductions until in 1935 when the rate on rural schools, formerly $1.50 per hundred of insurance, was reduced to $1.00 per hundred. Losses have also been substantially reduced since the agreement became effective. This agreement came as a compromise plan after it was found by the trustees that they did not have legal authority to organize a plan of self-insurance.

A number of texts on school administration deal more or less extensively with school plant insurance. Among these are Engelhardt and Engelhardt (386), Reeder (396), H. P. Smith (398), and Womrath (403). These are not reviewed here because such materials of research character as are reported in these are already in accessible form. Also, there are a number of minor studies in which the findings merely reaffirm those reported here. For that reason they have not been included.

At least two states, Idaho and Texas, voted in 1935 on bills setting up a state plan for school plant insurance. In Idaho, the bill passed the House by a vote of forty to eleven, but failed to get to the Senate, along with several hundred other bills. In Texas the bill was favorably voted out of the House Insurance Committee but failed to reach the floor of the House, largely, it is reported, because of its highly controversial nature. In 1933, a joint legislative committee in Ohio prepared a bill setting up a plan of state insurance for school property. However, this bill, along with a number of other measures designed to reduce school costs, was not enacted into law. In 1935, another joint Ohio legislative committee appointed a sub-committee to study this problem again. At the time this is written, this committee has not yet reported.

Conclusions

An analysis of the materials in this field point to the following conclusions:

1. Within the last five years, interest in the problem of school plant insurance has greatly increased due, no doubt, to the efforts of school officials to decrease school costs with least detriment to the educational program.

2. Practically all studies on the comparison of school insurance premiums and losses to school property have shown losses relatively low as compared with premiums paid. In Ohio, where studies of this comparison by individual districts for a four-year period have been made, it was shown that losses in relation to premiums were 2.8 percent in 1930, 10.2 percent in 1931, 3.9 percent in 1932, and 9.8 percent in 1933.

3. Chiefly because of the findings pointed out under two, the trend in the schools throughout the country seems definitely in these directions:

   a. Co-insurance, in which the loss hazards are shared by the owners
   b. General reductions in the amount of commercial insurance carried, particularly on fire-resistive buildings
   c. Appraisal of property to determine the actual insurance necessary for adequate protection
   d. Plans of self-insurance, either by states or individual city school districts
   e. Elimination of all insurance protection.

According to the most recent data collected by the National Education Association (426), the median salaries paid school janitors are shown in Table 9, and are compared with the median salaries paid teachers.

TABLE 9.—MEDIAN SALARIES PAID SCHOOL JANITORS AND TEACHERS, 1934-35, AFTER THE NATIONAL EDUCATION ASSOCIATION (426)

Population group	Median salary			
	Head janitor	School janitor	Elementary teachers	High-school teachers
Over 100,000	$2,333	$1,211	$1,922	$2,436
30,000 to 100,000	1,867	1,233	1,412	1,834
10,000 to 30,000	1,348	1,182	1,231	1,603
5,000 to 10,000	1,365	949	1,050	1,379
2,500 to 5,000	1,362	922	961	1,260

Ganders and Reeves (414) studied the present status as regards age, race, sex, physical health, place of birth, marital status, intelligence, educational qualifications, and experience. The same writers (415) also analyzed the attitude of janitors toward their work and their ability to get along with others. Another study of the status of the school janitor was made by Vander Meer (436). This investigation was confined to the Rocky Mountain region. Reeves and Ganders (430) stated that merit, rather than seniority, should be the basis both for promotion and salary increases, but show, however, that the correlation between salaries and years of experience for all members of the janitorial-engineering service in three cities ranged from .421 to .620.

Training of Janitors

Garber (416) concluded as a result of his study made in 1922 that,

> From the loose, careless manner in which a great deal of the janitor service is rendered, it is evident that a large percentage of the janitors are not only ignorant of the principles underlying their work, but of the best methods of performing some of their most elementary duties, such as cleaning, oiling, and care of floors; how to make and use sweeping compounds; proper methods of dusting, washing windows, and cleaning toilets. Instruction that would bring about improvement even in such matters would be of great value in raising health and housekeeping standards, and could be given in any school system.

Garber found, however, that at that time less than 5 percent of the cities attempted to give instruction of any kind to their school janitors. Since that time other cities have started training schools for janitors and doubtless much progress has been made since 1922. Methods of training were described by Hammersley (419), Hallett (418), Womrath (438), Parker (428), and others.

CHAPTER VI

Operation and Care of the School Plant

THE DECEMBER, 1932 ISSUE of the *Review of Educational Research*, which was devoted to the subject of school buildings, included only brief mention of the operation and care of the school plant. This chapter will therefore include some studies made prior to the date of that issue. Under the subject of operation will also be included studies of the personnel engaged in operating the school plant.

Reeves (429), who has made one of the most extensive studies of janitor service, emphasized the importance of the school janitor and his service in the following connections:

1. School health and sanitation
2. The influence of physical conditions upon the comfort and learning attitude of the child
3. The influence upon pupils of order and cleanliness of buildings in the maintenance of discipline, the formation of character, and the acquirement of habits of cleanliness
4. The wider use of the school building and equipment by the school and the community
5. The care of the valuable public property in the form of grounds, buildings, and equipment.

Status of the School Janitor

Garber (416) made a questionnaire study of the school janitors in 1,109 cities. He found that only 7 percent of the cities used the civil service method in the selection and appointment of school janitors, and only 73 of the cities required applicants to pass a physical examination. About 75 percent of the cities, according to this study, employ their school janitors for the entire year rather than for the school term. Butsch (406), in a study of school janitors in Wisconsin, found that the average janitor was employed for twelve months at a salary of $1,400. Eells (409) made a study of personal data, income, and expenditures of the 75 members of the janitorial and mechanical staff of the Fresno, California, school system. Among his findings were the following: average age, 50; residence in city, 12 years; average tenure to date in the city school system, 6 years; hours worked, 55 per week, annual income, $1,568 of which 95 percent was received from the board of education.

Parker (427) investigated the social and economic status of 303 school janitors in four states. A comprehensive study of the status of the janitorial engineer was made by a committee of the National Association of Public School Business Officials (404). This committee stressed the importance of the careful selection of men as a necessary prerequisite of training.

Reeves and Ganders (430) state the principal objectives of courses in janitorial-engineering service as follows:

1. Knowledge of the principles of heating, ventilating, sanitation, and the care of school buildings
2. Knowledge of the correct use of the mechanical equipment of school buildings
3. Knowledge of the best tools, materials, agents, and methods to use in various phases of janitorial-engineering work
4. Skill in using the proper tools, materials, agents, and methods of procedure for the different janitorial-engineering jobs, under varying conditions
5. A scientific attitude in the study of the various phases of janitorial-engineering service, in order to effect the greatest efficiency of results and economy in time and energy
6. Attitudes which will lead to serious, wholehearted, and unselfish attention to the duties of janitorial-engineering service
7. Attitudes which make for harmonious cooperation with pupils and with the administrative, educational, and janitorial-engineering forces
8. Ideals of what constitutes good janitorial-engineering service and of the importance of the service to both the educational work of the school and the protection of school property
9. Appreciation of beauty, harmony, and cleanliness in and about the school building and grounds.

Hoeper (420) attempted to ascertain the need for and trace the development of pre-training of janitors in Missouri schools. He also made recommendations regarding the training of janitors prior to employment. Jenkins (421) devised a self-rating card to aid janitor-engineers to improve themselves in the performance of their duties while in service. McKee (424) prepared a similar self-rating scale.

As a basis for evaluating the efficiency of the work of the janitor-engineer, Engelhardt, Reeves, and Womrath (410) prepared a score card which lists practically all the usual activities and gives a numerical value for each. This card has been supplemented by a compilation of standards upon which the activities are rated (411).

Methods and Equipment

Studies of methods of performing the various activities of operating the school plant which may be properly classified as research are relatively few. Numerous school systems, including Hackensack, New Jersey (417), Minneapolis, Minnesota, (425), and Evansville, Indiana (431), have adopted regulations designed to cover most of the duties of school janitors and engineers; but these have been largely based upon established procedures and by a trial and error process. Carter (407) analyzed 150 sets of rules to determine types of custodial service required by school-boards. Garber (416) found that there was very little agreement as to definite standards of janitor service in cities.

The United States Bureau of Standards (435) prepared an excellent bulletin which deals with the proper methods of caring for all types of floors. Reeves (429) made probably the most complete study of the janitor's equipment and methods of work, particularly in the various types of cleaning. The following are some of the conclusions resulting from his study:

1. Vacuum cleaning is superior to brush cleaning in quality of results, speed and economy.
2. Oiled floors from the standpoint of ease and speed of cleaning are superior to unoiled floors.
3. The soft cord duster with handle is more efficient than other types tested.
4. In cleaning glass, a little ammonia or kerosene in water applied with a cheesecloth and dried with a chamois is better than other methods.

Garber's investigation (416) found that of 1,097 cities, 891 use brush or broom with sweeping compound for cleaning floors; 276 use the oiled brush; 222 use vacuum cleaners; and 366 use two or more of the methods mentioned.

Reeves and Ganders (430) conducted numerous investigations and experiments concerning various methods of performing the varied activities of the school janitor-engineer. They gave a large amount of detailed information on such activities as the cleaning of floors, dusting, care of toilet rooms, cleaning of glass, blackboard and eraser cleaning, operation of heating and ventilating systems, care of school grounds, and care of electrical equipment.

Operating Costs and Economies

Administrators have found one of their greatest difficulties in the incomparability of the financial reports which come before them from other cities. This is due to the fact that the reports are not constructed on the same basis, and classification of items differs. It is thus very difficult to secure meaningful figures on operating costs. Womrath (437) illustrated this by data obtained from reports to the United States Office of Education, which show the total cost per pupil of operation to range from $4.60 to $15.69 among a group of cities. Fowlkes, Anderson, and Jones (412) attempted to secure data on the costs of operating supplies in 30 cities located in 18 states. They found considerable difficulty in comparing the data, but concluded that the per capita cost for operating supplies should not be lower than 30 cents nor higher than 60 cents.

Tilt (434) studied the operation and maintenance of school buildings by the contract method in comparison with the regularly employed staff. His conclusions favored employing a regular staff. Linn (422) prepared a checklist designed to determine possible economies in the operation of the school plant. He (423) also suggested six general methods for reducing electric power costs in schools. Schwartzentraub (432) made a study of the cleaning service in the Hamtramck, Michigan, public schools and showed the influence of furniture and equipment upon cleaning costs. Frostic (413) has described equipment that can be used by building employees to avoid expensive plumbing repairs. Bosshart (405) also prepared an outline of suggested economies in operating and maintaining school buildings, grounds, and equipment. Swoboda (433) studied the experience of a school district in Pennsylvania in providing its own electrical power. He presented cost data over a four-year period so that comparison with cost of purchased power could be made. He concluded that it was more economical to generate power. Demary (408) made a series of tests of both hand-fired and stoker-fired furnaces with the conclusion that in every case the efficiency of the plants producing power was considerably higher than those where heat only was produced. In only one case did hand-fired plants show an efficiency over 55 percent, with an average of 35 percent. Stoker-equipped plants showed an average efficiency of 72 percent.

Conclusions

That the problems of school plant operation have been seriously neglected is impressed upon anyone who makes a study of them. The personnel responsible for operating school plants have been notoriously inefficient and poorly trained. Little help has been given to them through the medium of research. This seems inconsistent when it is considered that school janitors and engineers are responsible for buildings and equipment costing large amounts of money and that the health and comfort of school children is largely their responsibility. If the studies cited in this chapter seem scattered and in some cases superficial, it should be borne in mind that from the standpoint of research this is largely an unexplored field and each investigator has not had the advantage of numerous other studies of allied problems to assist him.

CHAPTER VII

Types of Construction and Materials as Related to the Original Cost, Maintenance, and Operation of School Buildings

IN THIS COUNTRY and abroad considerable effort is being exerted to maintain the educational efficiency of the schools under reduced budgetary allowances. Schoolhouse planning and construction have received a study and attention in the last decade which assisted materially in maintaining and improving that educational efficiency.

The presentday conception of school planning is the provision of the correct space and facilities for all courses of study and activities to be offered, with the proper relationship between these and with sufficient flexibility in the building arrangement to permit economical building alterations to be made from time to time as the educational program makes such building changes necessary or desirable. A well-conceived plan is one of the most important factors in true economy in school building costs.

The materials used throughout the construction furnish the basis for additional economy, important not only at the time of the construction of the project but throughout the years of utilization of the building, during which wise selection is rewarded by reduced costs for operation and maintenance of the school plant. Herein architects and school building officials are constantly challenged to distinguish between economy and cheapness. Too frequently has occurred the error of striving for a low first cost with the result that the taxpayers are burdened with a building the maintenance and operation of which is disproportionately costly.

Materials used in the construction of a school building are determined principally by the type of architecture and the classification of construction. The Building Code Committee of the United States Department of Commerce named six general types of construction according to the character of the materials employed and the method of assembly. These are:

Type 1—*Fully protected construction* is that in which walls are of masonry or of reinforced concrete and the structural members are of incombustible materials having an ultimate fire resistance sufficient to withstand the hazard involved in the occupancy, but not less than 4 hours for bearing walls, fire walls, party walls, piers, columns, trusses, and for girders which support walls; 2½ hours for walls and girders and for roofs; and in which the degree of fire resistance for other construction features and the materials acceptable for the purpose are as given in the code.

Type 2—*Protected construction* is that in which walls are of masonry or reinforced concrete and the structural members have an ultimate fire resistance of not less than 4 hours for fire walls and party walls; 3 hours for bearing walls, piers, trusses other than roof trusses, and columns and girders supporting walls; 2 hours for walls, columns, and girders not otherwise specified; 1½ hours for floors, including beams and girders, roof trusses except as provided for in section 11-2-3, and for roofs except as provided for in section 11-8-1; and in which the degree of fire resistance required for other construction features and the materials acceptable for the purpose are as given in the code.

Type 3—*Heavy timber construction* is that in which walls are of masonry or reinforced concrete and the interior framing is of timbers, or in part of protected steel or reinforced concrete having an ultimate fire resistance of at least 1 hour, except for roof trusses as specified in section 11-2-4, the plank floors and roof being arranged in heavy solid masses and smooth flat surfaces, avoiding thin sections, sharp protections, and concealed or inaccessible spaces; and in which the degree of fire resistance required for other construction features and the materials acceptable for the purpose are as given in the code.

Type 4—*Masonry wall and joist construction* is that not included in Type 3 in which the exterior walls are of masonry or reinforced concrete and the interior framing is partly or wholly of wood or unprotected iron or steel.

Type 5—*Wood frame construction* is that in which structural parts and materials are of wood or are dependent upon a wood frame for support, including construction having an incombustible exterior veneer.

Type 6—*Unprotected metal construction* is that in which the imposed loads are carried by an unprotected metal frame and in which the exterior walls and roof are of sheet metal or other incombustible material.

The term "fireproof" has been widely used but inadequately defined with the result that structures varying considerably in fire resistance have been included within the term at various times and places. The Committee believes the terms "fully protected" and "protected" more nearly describe the fire resistance of each type.

With the introduction of numerous new materials, a much wider choice than heretofore is now available. It requires painstaking study and analysis, however, to make the proper selections. A school system which is sufficiently large can, to a certain extent, function as its own laboratory by trial use. Testing laboratories and requirements as set up by the Bureau of Standards and the American Society for Testing Materials would serve as a guide in venturing forth upon some of the new materials.

The proper material for the important structural parts of a building, such as the foundations, the walls, and the skeleton frame, should be selected by the architect or engineer responsible for the design. Opinions will differ as to the respective merits and costs of wall bearing, reinforced concrete skeleton frame, and structural steel skeleton frame types of construction. There is merit in each of these, and the final decision should be made in the light of bearing values of the soil, shape and size of the structure, and cost conditions in the particular vicinity in which the building is to be erected.

There are numerous types of floor and roof construction, many of the newer following the idea of a lesser dead weight, at a subsequently lower cost. In adopting these lighter types, one should consider the likelihood of recurring higher annual cost for fire insurance.

It is reasonable to suppose that floor systems of reinforced concrete would best lend themselves for use in fire-resistive buildings intended for long-term occupancy. Maintenance of such floor construction, when properly laid, is a minimum. Initial cost, however, is higher than for some of the lighter types of construction.

Frequently the finished flooring for classrooms, as selected by the architect, follows the express wishes of the school authorities. A questionnaire sent to many school systems a few years ago revealed that opinion lay between hard maple and linoleum floors as the first choice. Both possess resiliency and are not too noisy. There appears to be little difference in the cost of caring for these floors year in and year out. If the linoleum is made to conform to the United States Navy specification and is cared for by waxing about three times a year, there seems to be no reason why it would not stand up equally with maple flooring under the same usage. Flooring for other occupancies is selected to withstand the particular usage intended and to permit of easy cleaning. For example, in corridors, the flooring materials possess characteristics of noiselessness. Gymnasium floors afford resiliency, non-slipperiness, and yet are suitable for dancing. Kitchens, shower rooms, toilet rooms, slop sink rooms, and the like have floors of such materials as will permit scalding and flushing with water.

Interior sidewalls in the majority of school buildings are finished with plaster extending from the ceiling to the base. Plaster is finished in either white putty coat or sand finish preparatory for paint to be applied to it from time to time during the lifetime of the building. The wainscot in stairhalls, corridors, toilet rooms, and other special occupancies frequently is built up of masonry units of brick, tile, or terra cotta. Marking upon these is difficult, they can be readily cleaned, and there is little cost for upkeep, although the original cost is somewhat higher than that of plastered walls.

It has become generally known that school buildings of fireproof construction almost always have much of their occupancy unsatisfactory from the point of view of acoustics. There should be incorporated in the specification for construction a schedule of the acoustical materials to be used, principally in the ceilings of the various occupancies, the type and amount for each depending upon the particular occupancy. While such treatment is somewhat more costly than ordinary plastering, if properly done at the time of construction, it will obviate the need for going back into these rooms after the school has been put into use and attempting to correct each room by the application of a material over what was originally intended to be the finished surface.

The type of windows to a considerable extent is dictated by the architectural design. These may be of either the double hung or the projecting type, in wood or in metal. Climatic conditions enter largely into the correct selection. Where play space is somewhat restricted and the danger of glass breakage consequently increased, such glass replacement would be held down in cost by a design which cuts up the sash into six or more lights.

The interior trim throughout the building is preferably of a hard wood, finished in such a manner as to reveal the beauty of the grain and to permit of easy and rapid dusting. The experienced schoolhouse architect designs the interior free from ledges and projecting surfaces, simplifying the moldings, panels, etc., and achieving beauty by simplicity of line. This makes it possible for the cleaning force to do a thorough job of removing the dust after sweeping each day, without too much effort, thus affording a higher degree of sanitation.

The toilet rooms of a school building offer the greatest challenge in the selection of satisfactory materials. By arranging the terrazzo or tile floors in boys' toilet rooms to pitch to a battery of china stall urinals, it would be possible to flush these with a hose during the noon recess and again after school from hot and cold water connections provided in each toilet room. With daily attention to this and with the usual system of mechanical exhaust from toilet rooms, there is evidence that these rooms can be kept as clean and odorless as they were when newly constructed.

Toilet partitions of marble or similar material are ideal. Although the first cost is high, they require little maintenance and do not lend themselves to pernicious marking. Thick wire glass partitions with hammered surface, engaged in a metal frame, while not free from maintenance like marble, nevertheless have the advantage of being unsuited for marking and permit the diffusion of light throughout each toilet compartment.

In elementary schools the placement of wash basins in a recess in the corridor just outside the toilet rooms materially lessens the amount of cleaning to be done and reduces the number of stoppages in sewerage lines.

Stairs obviously show usage more quickly than almost any other part of the building. Because of this there are special precautions to be taken in selecting the materials making up the finished treads. The manner in which the stairs are placed in the building, whether or not they are enclosed in a stair tower or hall would affect the final decision since, if these are enclosed somewhat from the rest of the building, the noise emanating from them will not be so objectionable. In such cases, metal, hardened concrete, stone, slate or tile treads can be used. If a quieter tread is desired, these may have fillers of mastic, asphalt, rubber tile, or linoleum back of a safety nosing.

An opportunity to effect substantial economies exists in the mechanical services. Too frequently are found leaky steam connections, dripping faucets, and poor traps, all of which permit of a loss each hour they remain in disrepair. The total annual loss easily becomes one of considerable magnitude.

Surely there is no economy in adopting a policy of designing the sizes of mechanical services only to the limit of present working capacity, since changes in the curriculum invariably make additional mechanical services necessary as time passes, and ordinary usage soon takes its toll in efficiency. Pipes and fittings through which hot water flows should be made of brass or copper to avoid the probability of replacement in the next decade. Drain lines from sinks in laboratory or shop, where any reasonable opportunity exists for acids to be dumped in them, should be made of special acid-resistive materials. Even though these cost considerably more than ordinary drainage pipe and fittings, the increased expenditure would prove an economy. High-grade faucets and valves prevent frequent repairs. The alternative is wasted steam and water.

The Board of Fire Underwriters, through its nationwide inspection, controls to a considerable extent the kind of materials used and the installation of electric wiring. The amount of light to be provided is not their concern, however. As in cases of other mechanical services, it will again be found economical to provide a switchboard and main and branch feeders of a capacity beyond the requirements of the first design so as to have available spare circuits for the subsequent installation of additional instructional equipment which would make possible alterations to the school building as the years go by, in order to meet the changes in the courses of study that are constantly taking place.

A sizeable proportion of the operation costs in most schools is represented in fuel for heating. The architect should, therefore, design the exterior walls and roof with an exact knowledge as to the extreme temperatures to be met in the locality. Rapid heat transfer through walls and roof constitute a considerable waste. These should be designed against such conditions and thus make the building more comfortable also in warm weather.

There are two or three important factors in the selection of the materials for the exterior of the building, the nature of which must necessarily be determined by the architect so as to be properly related to the design. Where masonry units are used, mortar becomes of great importance. No attempt should be made to economize here; otherwise there will be shrinkage, causing wall leakage and subsequent disintegration not only of the mortar but of the masonry units themselves. The flashing of walls to prevent passage of water through them in a vertical direction is receiving much attention where high-grade construction is wanted. Such flashing, properly applied, largely prevents disintegration of mortar joints, efflorescence, and damp walls and floors.

Careful consideration should be given the selection of the roofing materials. These depend upon the character of roof and type of architecture. They should be of good materials of such construction as to permit readily finding leaks from the outside or inside, and with all metal work in connection therewith made of copper or zinc, if it is desired to keep maintenance costs at a minimum.

In conclusion, experiences of those continuously engaged in the operation and maintenance of large school properties indicate the wisdom of making higher initial investments in many materials and articles of equipment which are required to stand up under the heavy wear and tear to which the average public school building is subjected.

CHAPTER VIII

Plant Development for Higher Education, Including Junior Colleges

RESEARCH in the field of college and university building planning has been less extensive than in the case of the public elementary- and secondary-school plant. There have been relatively few generalized attacks on the major problems involved. Study has been confined for the most part to the individual building projects of specific institutions. Nevertheless, a surprisingly voluminous literature has developed. Workers in this field are indebted to the painstakingly collected bibliographical compendium of H. L. Smith and Noffsinger (623) which cites, classifies, and briefly annotates over two thousand references on college and university buildings, grounds, and equipment. A perusal of this bibliography, however, discloses the fact that over 80 percent of these entries go no farther than to reproduce floor plans and photographs and describe them more or less briefly. There are only a very limited number of studies which could properly be characterized as research.

The most important publications in the field of college plant planning are two volumes sponsored by the Association of American Colleges through its Commission on College Architecture and College Instruction in Fine Arts. The first, *College Architecture in America* by Klauder and Wise (553), was published as a joint undertaking of this commission and the Carnegie Corporation. It contains a historical treatment of early college buildings, an extensive survey of general campus development plans, and detailed discussions of administration and academic buildings, libraries, chapels, auditoriums, dormitories, dining-halls, museums, and buildings for science, engineering, art, athletics, student welfare, and plant operation and maintenance. It emphasizes principles and standards of planning and is copiously illustrated with photographs and floor plans.

The second volume is *Architectural Planning of the American College* by Larson and Palmer (560). It grew out of the work of the architectural advisory bureau at the headquarters of the association, and devotes major attention to the liberal arts college. The association had built up a large collection of data on recently constructed college buildings and the authors had served in an advisory capacity to a number of institutions confronting building problems. The report follows much the same pattern as the first volume, with extended discussions of character in college architecture and an excellent analysis of relationships between architect and college. Various types of specialized college buildings are presented with a wide variety of illustrative material.

Representative of general surveys of university plants is the volume by Reeves and others (603) in the University of Chicago Survey. Appraisals were made of site, service facilities, recitation and lecture rooms, laboratories, and offices. Both buildings and classrooms were rated by brief score cards. Natural lighting was reported more inadequate than artificial lighting, and on a general room rating, 89 percent of the classrooms were reported either satisfactory or potentially satisfactory. The average amount of office floor space for professors was 207 square feet; for associate professors, 182 square feet. An extended analysis was made of the utilization of classroom space. On the average, 95 classrooms in 15 buildings were utilized 59.3 percent of the total possible periods during an eight-hour day. On the basis of a 44-period week, the percent of utilization dropped to 17.6. Recommendations include the provision by partitioning of a larger proportion of small classrooms and the abandonment or conversion of some classroom space.

Other examples of general plant surveys are those by Reeves and others (601) and the Maine higher education survey (466). The first tabulated and discussed a wide range of factual material on the physical condition of 345 buildings on 35 campuses of institutions under the jurisdiction of the Board of Education of the Methodist Episcopal Church. There is a comprehensive analysis of building utilization, and recommendations are made in terms of generally accepted standards. An estimate of $20,000,000 is made as the amount of new construction necessary to furnish adequate housing for these 35 colleges. The Maine Survey (466) is somewhat unique in that it utilized as the basis for plant analysis the score card technic. The four institutions surveyed scored 377, 567, 618, and 644 out of a possible score of 1,000. Recommendations for plant improvement and extension were made in terms of the objective data provided by the scoring.

Evenden (499, 501), in collaboration with Strayer and Engelhardt, has applied the scoring technic originally developed for public school buildings to college buildings and to the physical plant of normal schools and teachers colleges. The scores are to be recorded on the basis of standards outlined in bulletins. The weighted scores for individual items are in fives or multiples of five. The 1,000 points on the college card are distributed: site, 140; buildings, 160; service systems, 185; instruction rooms, 280; general units, 235. For teacher-training institutions, the distribution is: site, 110; buildings, 155; service systems, 175; instruction rooms, 220; practice schoolrooms, 180; general units, 160.

College library planning is most adequately treated by Gerould (508), librarian of Princeton University, whose material is based on personal visitation to fifty representative colleges. The experience of these institutions is critically evaluated and general principles and standards set up and discussed for all major phases of library planning. He recommended centralized housing of all collections. Ample provisions must be made both immediately and in flexible plans for enlargement for four major services: undergraduate study, study by advanced students or faculty, the administrative work of the library staff, and the shelving and storage of books. He recommended also minimum reading-room accommodation for 30 percent of the student body and stack room for at least twice the number of books in the library when the building is opened. The discussion is characterized throughout by a wealth of specific and detailed suggestions on all important issues.

Turner (642) provided an interesting series of plan types of college and university libraries, including several from Canadian and English institutions.

McHale and Speek (571) reported a series of papers presented at a conference on housing college students, covering dormitory design and planning, equipment, food service, and financing. They also contain brief descriptions of housing plans at a number of institutions and special reports on the newer housing plans commonly called cooperative houses, designed to reduce students' expenses.

Hayes (529) discussed suggested standards and recommended procedures for all phases of planning of student residence halls. A critical summary of existing standards was provided and specific advice given on the general planning process, site, size, floor plans, staff accommodations, social life, food preparation and service, safety and welfare provision, floors, walls, heating, ventilation, and lighting.

Bryan and Handy (472) outlined requirements and specifications for the furnishings and equipment of residence halls.

Facilities for practice or laboratory schools in connection with the teacher-training programs of colleges were treated by Mead (574, 575, 576, 577) and Wrigley (657). Mead presented data on the cost of present schools and deficiencies in their design and layout. Wrigley's study was confined to the training school plants of the state teachers colleges in Pennsylvania. He found no institution with adequate facilities and made numerous suggestions for improvement.

Hamon (523) made the most extensive analysis of utilization of college instruction rooms. He gathered and classified data on 1,393 classrooms in 22 colleges by type of institution, type of room, period of day, and weekly load. He found heavier use of recitation and lecture rooms in the periods before lunch, and a correspondingly heavier load on laboratories in the periods after lunch. He showed somewhat higher utilization measures for teachers colleges than for other types of institutions.

Knox (556) outlined a comparative cost analysis of four similar university classroom buildings constructed in the same geographical area from 1928 to 1934 and varying in cost from sixty-eight to thirty-one cents per cubic foot. The analysis was broken down by foundations and framework, exterior facias, roof coverings and interior partitions, interior finishes and surfacing, mechanical and electrical equipment, and general equipment. He tabulated in detail the structural features and schedules of finishes and showed plan and elevation sketches. This illustrates a usable technic of cost comparison.

Joyal (546) developed the following minimum standards for the establishment of a junior college: area with radius of twenty miles, minimum high school with average daily attendance of 1,250, minimum junior college with average daily attendance of 200, eight full-time teachers, 120 periods of work per week, and $16,000 per year for current expense.

Junior college housing has been studied intensively in doctoral dissertations by Chamberlain (477) and Hardesty (526). Data for the first were gathered by personal visitation to thirty junior colleges located in Illinois, Iowa, Kansas, Michigan, Minnesota, and Missouri, with a range of enrolment from 21 to 759 and a median of 108. Two were housed separately, fifteen were classified as joint housing with partial segregation by floor or wing with certain rooms reserved for college work, and thirteen were housed jointly with other units without special effort at segregation of college classes. A detailed classification of the building facilities available and in use is made by type of room. As factors in the prediction of enrolment, a public junior college will on the average have a freshman enrolment approximately 50 percent of the twelfth-grade enrolment for the previous year in the same system. The total enrolment will approximate 12.8 percent of the total high-school enrolment. The sophomore enrolment will approximate 50 percent of the freshman enrolment. There is a significant negative relationship between the size of the fee charged and the enrolment. The number of room-periods per week will approximate 110 percent of the enrolment and will be distributed 62 percent for academic and 38 percent for non-academic work. With respect to administrative organization, it is recommended that the junior college and high school be under the control of a single individual responsible to the school superintendent, that periods be uniform for both, and that the 6-4-4 organization be set up as the ultimate objective. Dual housing and joint use of facilities by high school and junior college is the trend. The facilities required for "a reasonable program of studies at an effective junior college, in the light of present practice" would include a laboratory or laboratories equipped for offering instruction in general inorganic chemistry, qualitative analysis, quantitative analysis, and organic chemistry; a drawing room with facilities adequate for work in beginning engineering drawing, descriptive geometry, and advanced drafting; a woodworking and pattern shop; a foundry; a machine shop; a forge room; a physics laboratory equipped for offering work in mechanics, sound, heat, light, magnetism, and electricity; a biology laboratory equipped for giving instruction in general zoology and general botany; an accounting room; an electrical laboratory; a gymnasium and the field facilities necessary to offering the physical education work generally required of college freshmen and sophomores; lecture rooms for chemistry, physics, biology, and electricity; and academic rooms, administrative offices, library and study room, an assembly or auditorium, and facilities for college athletics, including a gymnasium, an athletic field, and, under standard conditions, a swimming pool, club rooms, and a publications room.

Complete and detailed standards are set up for all regular and special facilities. The study indicates that reasonably adequate housing is unlikely in any situation with a junior college enrolment of less than one hundred.

Hardesty (526) made a similar investigation of thirty-two California junior colleges, with a median enrolment of 400, which is four times larger than the median in Chamberlain's group. The differences in findings and recommendations are due largely to this difference in size. Four major functions of the junior college are discussed, i. e., guidance, terminal, preparatory, and adult education. Present housing conditions handicap adequate curriculum offerings, mainly in the field of work of a terminal vocational nature. A range in class size is reported from 1 to 324, with a median of 26. Median class size distributed by subjectmatter ranges from 16 in music to 37 in social studies. The following numbers are suggested for desirable, maximum, and minimum class size in the junior college:

Physical education, 50, 65, 15
Social studies, 45, 60, 15
Commerce, 40, 55, 15
English and science, 35, 50, 15
Foreign language, mathematics, art, and music, 30, 45, 15
Engineering, 25, 40, 15

A formula is presented as follows for determining the pupil-station capacity of a classroom:

$$PSC = \frac{RW - AW}{PSW} \times \frac{RL - ISD}{PSD}$$

PSC = pupil-station capacity, RW = room width, AW = aisle width, RL = room length, ISD = instructional-space depth, PSD = pupil-station depth.

To determine the length of a classroom, to accommodate a given number of pupil stations:

$$RL = \frac{PSC \times PSW \times PSD}{RW - AW} + ISD$$

Special attention is given to the requirements for library, auditorium, cafeteria, lockers, office needs, size of site, and location. Separate housing is preferred by 90 percent of the administrative officers in this study. Where dual housing is necessary, the consensus of opinion favors complete or partial segregation of the junior college classes in a particular wing or floor or building with certain rooms reserved specifically for junior college work; separate study facilities with either a combined or a separate library; combined administrative officers; dual extracurriculum activities and student-activity program; and same length periods for junior college and high school.

CHAPTER IX

Recent Trends in School-Plant Planning[1]

THE REPORT of the Commission on the Social Studies of the American Historical Association (660) declared that if the school is to justify its maintenance and assume its responsibilities, it must recognize the new world order and proceed to equip the rising generation to cooperate effectively in the increasingly interdependent society and to live rationally and well within its limitations and possibilities. Whatever may be the exact character of life in the society now emerging, it will certainly be different in important respects from that of the past. Kilpatrick (684) stated that our schools are changing, and that everyone in middle life can see how different the schools are now from those of his youth. Melvin (689) pointed out that the new school actually looks different from the old one. It is a walking-about school rather than a sitting-down one. The children may be doing anything that is good for them to do. It is not an institution run by rule and regulation, but a community of self-determining children, busying themselves about dozens of things. The new school is not a room with rows of seats where children stay still by the hour, but on the contrary it is a social organism in which the individual has great freedom to develop in and about buildings, around town, and often outdoors in the country. Moehlman (692) predicted that so long as social change continues, public education needs will also change, for they are at all times only a reflection of the community life about us. A changed public school has brought about changes in the school plant. An examination of the educational research covering the past few years seems to indicate the following significant trends in school-plant planning.

National Planning

The final report of the National Planning Board (696:30) gave these reasons for planning: (a) the necessity and value of coordinating our national and local policies instead of allowing them to drift apart, or pull against each other with disastrous effect; (b) the value of looking forward in national life, of organized preventive policies as well as remedial, or preventing the fire rather than putting it out; and (c) the value of basing plans upon the most competent collection and analysis of the facts. While the report does not mention schools specifically, it emphasizes the necessity for a wise and orderly procedure in regard to all governmental activities. Wise planning is based on control of certain strategic points in a working system—those points necessary to insure order, justice, and promote the general welfare. It assumes that the gains of civilization are essentially mass gains and should be enjoyed by the whole people who created them, rather than by special classes or persons. Beard (663) wrote that no government or society as a whole can escape the impact of this planning process. Laidler (686) pointed out that this nation on entering the World War really developed a national plan. Overnight the government created a skeletonized collectivist society. The railroad, the telephones, and the telegraph systems were brought under federal control. The policy of laissez faire was held in abeyance, and leaders from Washington did much to fit the plans of each one of the basic industries into a larger national scheme. Viles (708) urged the adoption of a national schoolhousing program. He cited four reasons for such a move:

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[1] This chapter was prepared under the supervision of Dr. N. L. Engelhardt, Teachers College, Columbia University, New York, N. Y.

1. Federal funds are needed to build rural schoolhouses in certain areas.
2. The funds should be given on the basis of an outright grant, the same as for roads.
3. Federal funds should be provided only after a survey has been made and the need established.
4. The aim of the program should be to set up desirable school units.

In December, 1934 a conference on state school legislation and long-time educational planning was held in Washington, D. C., under the auspices of the Joint Commission on the Emergency in Education. The purpose of the meeting was to bring together a representative body of American educational leaders to consider the problems of education in relation to our political, economic, and social structure. School-plant planning was one of the topics that received careful consideration.

Relation of City Planning to School-Plant Planning

After studying the relationship that has existed between city planning and school-plant planning, and showing the need for a greater cooperation, R. A. Holy (682:155) made the following recommendations:

1. It is within the sphere of competency of the school authorities to initiate city planning and zoning movements.
2. The school needs of the community should constitute a principal consideration in the preparation of any city plan or zoning scheme.
3. The city plan and zoning regulations should function as the framework for the school plan.
4. The activities of the zoning and planning authorities on the one hand and the school authorities on the other should be carefully coordinated.
5. Provision should be made for easy exchange of all items of information which can be prepared by one planning body and are needed for the proper functioning of the other.

The study pointed out the ultimate relationship that should exist between city and school-plant planning if either is to accomplish its end. In spite of the need for a close relationship, there has been very little effort to coordinate the work and such lack of coordination has resulted in frequent and costly mistakes. The study further showed the importance of school-plant planning and city planning being advanced concurrently at all times. The school-plant program should be a definite part of the city plan and its treatment should be from the point of view of the educator. The organized planning of the future will undoubtedly deal more and more with the relationship of all community activities and with the relationship that should exist between urban communities and suburban and rural areas. It will be necessary for all individuals and agencies interested in planning to cooperate to secure the desired ends, because city and school planning officials have ultimately a common goal—the welfare and betterment of the community and its citizenry.

The part which the state should play in school-plant planning was pointed out by Hill (681). Some of the basic principles behind the agitation for school-planning departments were: (a) school administrators have placed the emphasis on the essentials of administration and teaching; (b) education has not been able to interpret its needs to the architects; (c) standards should be set up that would prevent the building of unsatisfactory school buildings; and (d) architects do not always interpret the instructional programs.

The National Advisory Council on School Building Problems was organized by the United States Office of Education in 1929 for the purpose of providing a clearing-house of information on all problems relating to the planning and construction of school buildings (662). School building exhibits, showing trends in school building construction, have been held in various sections of the country.

A Functional School Plant

That significant changes in school-plant planning have taken place during the past century is clearly brought out in Long's study (688). He pointed out, however, that changes in curriculum were not visible in schoolhouse architecture prior to 1900 other than the building of classrooms for each grade. School building programs during the twentieth century have lagged far behind the needs of curriculums. Even today school buildings are constructed that are copies of those built about a century ago. Long's study indicates that there is now a tendency to make elementary schoolhouses more flexible. More of them are being provided with auditoriums, gymnasiums, and special rooms. Most presentday school buildings are not good examples of functional plants, and the literature of the field seems to indicate there is general agreement with Long when he (688:32-33) says:

> No doubt some of the more alert and progressive school administrators have become aware of the environmental needs of the modern elementary school curriculum, but up to the present time few school plants have been erected that provide adequate facilities for carrying out the more progressive type of education. We should be able to look forward to having more aid given to the development of a suitable educational program through buildings, equipment, and grounds planned specifically for the purpose which they are to fulfill.

Long's study of twenty progressive schools indicated that there was scant provision for flexibility and expansibility. He concluded that flexibility should enter into the provision made for service facilities. Better results would likely be obtained if the teachers, supervisors, and principals were allowed to participate in the planning and equipping of school buildings.

Hamon (677) indicated that the purpose of a school plant is to house a school program. In planning a school plant the dominating motive should be to provide for the child and his needs. The building should provide a healthful environment, should be architecturally pleasing, and should serve the functions which it houses. Correct planning requires the services of a superintendent who has an educational philosophy, as well as the services of an architect and an engineer. The report of a subcommittee of the White House Conference on Child Health and Protection (711) stated that the first responsibility of the school authorities is to provide a healthful environment for the child while in school. Schoolhouses should promote health rather than undermine it.

In his study of space provisions in seventy-two school buildings, Spohn (704) found the following trends:

1. A greater variety of space provisions
2. A trend away from separate laboratories for specialized science subjects
3. An increase in the provisions for home economics and commercial subjects
4. Larger space provisions for more specific types of shop work of a practical nature
5. More adequate facilities for an expanded physical education program
6. Separate rest rooms for teachers
7. More adequate office facilities tending toward a general office suite
8. A tendency away from general storage to specific storage rooms
9. More consideration being given to janitors' rooms, fireproof vaults, motion-picture booths, waiting rooms, club rooms, conference rooms, museum, armory, band room, and auditoriums as practice rooms.

An examination of Vischer's *Der Neue Schulbau* (709) indicates that changes in the school plant have taken place in Germany similar to those that have occurred in the United States. Some of the changes as indicated by Vischer are:

1. The expansion of the content of the course of study
2. A wider use of technical inventions to aid and supplement instruction
3. A greater attention to health and the physical comforts of the children.

In order to provide for these changes more flexible school plants have been provided.

Adaptation of the School Plant To Serve the Social, Recreational, and Educational Needs of the Community

That the school should assume a larger role in the social, recreational, and educational life of the community is accepted by most writers on the subject. Engelhardt (667) pointed out that the schoolhouse in the past has very frequently been thought of as a structure in which children were protected and safeguarded from the life of the community. The schoolhouse of the future should be visioned in different terms. He stated:

> It should be a community center, not only for keeping children under control and remote from the realities of life, but also a community center in which children and adults discuss the common purpose of the society in which they live and organize the principles according to which individuals must associate with the other members of society.

While it is generally assumed that the school should occupy a very important place in the life of the community, Pruett (699) found that the social and community uses of the school plant were given the least emphasis in the general standardization program, as less than 1 percent of the total items mentioned pertained to the local use of the school plant. According to Morgan (694), a community will use the school plant in a definite and constructive manner provided the school authorities will point the way. The school-community relationships really take on two forms: (a) those activities provided within the school's walls and on its premises in which the community at large may participate; and (b) the development of school activities that may be carried out from the school into community groups to enrich social life.

Harrison and Dobbin (679) emphasized a wider use of the school plant and stated that it is important to take into account the fact that the school of the future will not be a building that is used for only six hours a day, but rather it will be put to valuable use at least sixteen hours out of each twenty-four, and it will eventually develop that the greater portion of the rooms will be used for assemblies, demonstrations, and physical culture. Moehlman (691) suggested a broader conception of the use of the school plant and urged that all school buildings of the future be designed by educational specialists around the curriculum and extracurriculum needs of the child and the adult life of the community. Thompson (707) illustrated how a board of education showed foresight in planning a new structure that would provide for the increased school population and at the same time offer accommodations for certain community projects.

Moehlman (693) also stated that no school building should be located without first making an actual survey of the needs of the community. Since school buildings should be built to serve for fifty years, it is very important that they be properly located. It is no more extravagant to build high quality schools than it is to build high quality homes. If the school plant is to serve the needs of the local community, it must be flexible and expansible. Spain, Moehlman, and Frostic (703) even went so far as to say that the measurement of the physical efficiency of the school plant is best expressed in terms of flexibility, expansibility, freedom from hazards, traffic area, health requirements, and use and location in district to be served. Schmidt (701) suggested that new constructions must afford a maximum of flexibility in arrangement and permit such additions and changes as the future may demand. All original plans should include the probable future additions. Engelhardt (672) described an open-air school of Milan, Italy as being provided with school buildings and dormitories, lunch rooms, a chapel, a model home, a model stable, a model poultry yard, model fish ponds, running tracks, and swimming pools. It also contained vegetable gardens, fruit orchards, small experimental fields, flower gardens, vineyards, and lawns. The school buildings themselves are one-story, of four classrooms, each located in various parts of the grounds. All of the facilities of the institution are used for instructional purposes. Physically handicapped children live in it.

Flexibility

T. C. Holy and Arnold (683), writing on flexibility, stated that:

> Since it is not possible to foresee all the requirements of the future, every school building should be so planned and constructed that changes can be made when necessary in the length and arrangement of the rooms. A great amount of flexibility is secured through the "unit type" of construction which enables partitions at the end of rooms to be easily removed or changed. Heat and ventilating ducts, pipes, electric wires and switches, doors and windows should be placed in side walls of rooms in units of five, ten, or more feet in such a manner as to offer no difficulties in enlarging or reducing the length of any room. Equipment should be installed so as to make changes as easily as possible. Built-in facilities should not be so specialized as to make it difficult to readapt the rooms for other purposes.

Hart (680) also pointed out that flexibility in classroom size and arrangement is an extremely desirable feature of the school building in a growing community and that movable partitions give flexibility to classrooms. Shigley (702) stated that school buildings should be planned from the ground up so that they may be made to meet new demands. The classrooms should be flexible so that they may be made larger, if need be. He further showed that the new schools of New Britain, Connecticut, are planned for flexibility.

Hamon (678) emphasized the adaptation of the room to the number and size of the occupants, and the equipment and materials necessary to the desired activities of the occupants. He also said that some of the modern educational ideas which tend to influence the type of building to be built are: (a) socialization of the class period; (b) greater use of the basic muscles in handling large materials; (c) greater use of visual aids; (d) use of objective tests; (e) extension of the program to include music, art, elementary science, health, physical education, and the prevocational activities; (f) emphasis on extracurriculum activities; and (g) the changes in the school buildings necessary to meet the needs for kindergartens, high schools, junior high schools, and junior colleges. He maintained that the traditional room is not satisfactory to meet these changes. We must plan for an economical means of altering the room length, since that is about the only way to secure much flexibility in permanent school buildings. The children in the public school now handle much more educational materials in their work than formerly. Therefore, ample provision must be made for plenty of built-in space in the form of shelves, closets, cabinets, racks, etc.

Butterworth (664) made a study of special-room facilities in superior consolidated schools and found that most of the schools were fairly well equipped with rooms for some of the special work but especially lacking in some of the newer subjects. He found that the facilities for health education were very meager. There were no open-air rooms and only one building had a dentist's room. Fewer than one-fourth had a nurse or a school physician's office. Vocational rooms were much more prevalent than health rooms. Nine-tenths had facilities for homemaking classes, four-fifths had rooms for agriculture, one-half had rooms for commercial work, and two-thirds had woodworking rooms.

A Clarification of School Building Problems

On reviewing the thirty-third yearbook, part one, of the National Society for the Study of Education (697), one is cognizant of the scope of school building problems which are being uncovered and clarified by research studies. This yearbook presents a composite of expert judgment and in some parts some objective data. Those responsible for building schoolhouses may get from this yearbook valuable suggestions about policies, about planning, and about the interrelations of all the agencies involved in school building programs. The yearbook is divided into six sections treating thirty-four pertinent problems in school-plant planning. The titles of the sections are:

1. The Philosophy of the School Plant
2. School-Plant Planning Policies
3. Educational Services
4. Architectural Services
5. Constructional Service
6. Financial Aspects of the Problem.

Through an analysis of the school building problems in ten American cities in 1928, Engelhardt (670) clarified the specific tasks that are involved in school building programs. Surveys of the school building needs in these cities served as bases for specific recommendations for new buildings. This book, as well as many other studies, seems to indicate that the tendency is for a comprehensive school survey to serve as a basis for school building programs. Strayer and Engelhardt over a period of years have isolated many of the specific problems involved in school building programs. The standards developed by them for elementary-school buildings (705) and high-school buildings (706) set forth clearly many of the specific problems. These, with their accompanying score cards, may be used to great advantage in arriving at the scope of a school building program.

That important trends in school-plant planning have taken place was brought out by Engelhardt (671).

Special emphasis has been placed upon certain items which have not been given much consideration in the past. These items include such features as ample parking spaces for automobiles; the acoustics of classrooms, corridors and special rooms; provisions for radio and audio-visual education; kinds of lockers and types of locking devices; movable and built-in equipment in classrooms; the inclusion of an audio-visual studio; and emphasis upon specialized equipment for special laboratories and classrooms.

The lack of provision for many of the specific items of cost in school building programs was brought out by Misner (690). He discovered in his investigation that extra-cost items (items not included in the original contracts) and incidental costs (those which are not a part of the building's operations themselves) often result in a great waste of money for the community. By pointing out poor procedures in the planning and execution of school building programs, the use of this study should aid school officials in spending wisely the money appropriated for school building purposes. Misner developed a checklist of extra-cost items not covered in unit prices. He discovered that back of the excessive extra costs were:

1. Insufficient importance attached to work of an educational nature by the board of education
2. Boards placed too much emphasis on low estimations made by competing architects
3. Architects were allowed insufficient time between selection and the letting of contracts
4. Development of building plans without sufficient advice from educators.

Byrne (665) has done much toward the isolation of detailed problems of school building in his checklist of school building specifications. Although one may find the use of this checklist a rather tedious task, valuable suggestions for those responsible for school building specifications can be secured from it. Perhaps the most valuable contributions of this research are the guidance it gives by example and by pointing the way to further needs of scientific analyses of numerous problems involved in school building programs. The standardization of the various kinds of equipment used in school building construction should not be left to the manufacturers. A great deal more should be known about the personnel having the responsibility for writing school building specifications. Byrne's study is an example of many that will be made before schoolhouses can be constructed and equipped throughout on the basis of scientific information.

Standardization of School Plant Requirements

Standardization of schools was treated by Pruett (699). He found that rural and elementary standardization existed in thirty-five states. Each one of the thirty-five states included some items of the school plant in its standardization program, with the number of items ranging from 27 in Pennsylvania to 248 in Wisconsin. He found a total of 3,486 items of standards relating to school plants in the rural elementary standardization programs in the thirty-five states. There were 354 statements in the program of high-school accrediting agencies relating to the elementary-school plant. Of the total of 3,839 items he found 2,242 statements not duplicated by any two states. By far the largest number of items related to "Substances for the Sustenance of Life," such as air, light, water, and heat. Less than 1 percent of the total referred to the school plant. The standards used were largely subjective as is shown by the use of adjectives and adverbs. The word "good" appeared 236 times in the standards he examined.

High-school accrediting is practiced in all states except Nevada. High-school standards contain items relating to the school plant ranging from 8 in Virginia to 530 in Pennsylvania, or a total of 3,182. Of this number 2,407 are not duplicates. Approximately one-third of all items related to teaching equipment. Pruett also found that there was a close correlation between elementary- and high-school standards, the correlation being .7111. There was considerable duplication in the work of departments of state in matters pertaining to the school plant and he recommended that the work of standardization, or accrediting schools, be made by the state department as a whole and only when schools had done unusual or meritorious work in carrying out a well-rounded program formulated by the entire department.

Standardization of some phases of the school plant itself has been going on quite rapidly, as indicated by part one of the thirty-third yearbook of the National Society for the Study of Education (697). Thirty-eight states provided some form of legal approval of plans and specifications for public school buildings. In nineteen states it was required that all plans and specifications for school buildings be approved by some state agency. In the remaining sixteen states the state control does not begin until the cost of the structure exceeds a prescribed minimal amount ranging from $300 to $5,000.

Proctor's study (698) revealed the need for state supervision in the checking of architect's working drawings before the school buildings are allowed to be erected. He came to the conclusion that only through such state supervision of the school building program would the rights of the child be safeguarded and the taxpayers be assured of the most economical expenditure of the public funds. He further concluded that it is far more economical and far more desirable to supervise the making of the plans and the working drawings than to attempt to get results by inspecting the building after it is erected.

Sahlstrom (700), after studying (a) the status of the schoolhouse in municipal building codes; (b) the municipal code requirements for fire resistance in school buildings; and (c) the municipal code requirements for stairways, fire escapes, bearing walls, live floor loads, and sanitation, came to the conclusion that the state should gradually assume the responsibility for the supervision, management, and control of public school building construction. He came to this conclusion because (a) the municipal building codes generally failed to secure the differentiation of requirement so essential to the needs of individual types of buildings; (b) a majority of the school building ordinances failed in a conspicuous way to recognize the school as an individual structure with use and occupancy characteristics peculiarly its own; and (c) the attempt to classify the school with other more or less related buildings, and to govern the construction of school buildings under general requirements resulted in a loss in building efficiency, excessive costs in construction, and increased hazards to the life and health of the school children.

A Larger School Plant

Engelhardt and Engelhardt (668) stated that large units centrally located can serve the school population more economically and efficiently than can small units scattered throughout the community and housing only small numbers. There has been a distinct trend toward larger and more central schools. Statewide surveys like those in Missouri, Alabama, and Florida have clearly indicated that there are too many small schoolhouses. A. F. Harman, while state superintendent of schools in Alabama, carried forward a splendid program with respect to location, planning, and erection of school buildings. In Maryland, under the leadership of State Superintendent Albert S. Cook, standards for the location and erection of buildings have been very widely accepted and followed. Practically the entire rural plant of Delaware has been changed within the past ten years.

Altstetter (659) showed that there are larger classes and that they are here to stay. Larger classes mean larger classrooms which seriously affect school building plans. Rooms should be wider as well as longer in order to handle the larger numbers, which means that the problem of artificial lighting looms large. Frederick (674) emphasized four distinct high-school trends: (a) small high schools of fewer than 100 pupils will disappear as transportation facilities improve and the population moves from marginal lands; (b) the high school of the future will tend more and more to become a community high school in the sense that it will take a more definite part in and draw more extensively on the life of the community by which it is supported; (c) the six-year secondary school will become more frequent in smaller communities; and (d) in the high school of the future will be found 90 percent of the children of high-school age unless the CCC idea or the militarists offer greater inducements to the youth of the land.

Significant progress has been made during the past few years in the planning and building of schoolhouses. Much of the impetus has come from the initiation of professional courses in schools of education for the training of school executives in all fields of school management. An additional impetus has come from the survey movement. Recent school building surveys indicate that the theoretical development of standards has moved ahead far more rapidly than the acceptance of those standards and their incorporation in new construction.

Capital Outlay Expenditures

Grossnickle (675) discussed the relation of the state's minimum education program to capital outlay. He showed that at present there is no statewide plan in operation which equalizes capital outlay, although means by which a state may equalize for these purposes were suggested by Adams (658), Baldwin (661), Mort (695), and Weller (710). Grossnickle's study (675) grew out of an assumption made by Mort that there is a constant relationship between current expense and capital outlay. He came to the conclusion that regardless of the type of program offered, the ratio between debt service and current expense remained constant.

Moehlman (691) added that it is necessary to keep our credit clear so that we may save our borrowing power for time of need and operate our schools at full power during depression periods. He further stated that the best solution for financing buildings is to enter upon a complete pay-as-you-go program as soon as possible. Since present school districts are much too small for this policy, he suggested that the state make provision for the financing of the public school plant through moneys raised by current taxation. Essex (673) showed that the number of school districts using the pay-as-you-go plan increased slightly, from 28 percent in 1923, to 37.8 percent in 1927. He further stated that it will be impossible for all districts to adopt any one plan in its entirety. One plan might be better for one district, while another plan would be better for others. He pleaded for the financing of school buildings on a basis that will be fair and just to all concerned. As the pay-as-you-go plan eliminates all interest cost, the general trend he thinks will be in that direction.

Engelhardt, as reported in Essex's study (673), endeavored by questionnaire to find the use of the pay-as-you-go plan. He sent questionnaires to 250 cities having a population of more than 30,000. He found that 10 percent of all cities reporting used the pay-as-you-go plan in full, while 18 percent used it in part. He also found that there was a slight tendency to finance elementary schools on the pay-as-you-go plan.

Cowen (666) pointed out that the pay-as-you-go plan appears to be ideal for communities that complete the same number of buildings every year. Such a plan avoids the payments of interest on bonds. While such a plan does not earn interest for the taxpayers, as does the reserve plan, it leaves the money with the taxpayer until it is needed to pay for construction. He further pointed out that in small places where school buildings are constructed infrequently and where the creation of a reserve fund may not be practical, the financing of schools on a statewide basis would make it possible to use the pay-as-you-go plan or some cooperative fund. In case this cannot be done every effort should be made to avoid long-term bond issues. In case bonds must be issued to build a school, they should be retired by all means before the next school is built.

The trend during the past few years regarding the amounts spent for school buildings, sites and equipment, as shown by Grotz (676), has been a decreasing one. Prior to 1925 the normal ratio of capital outlay to expenditures was 20 percent. In 1934 the ratio was only 5.5 percent, not counting allotments from the Public Works Administration. Even by counting the PWA allotments, the expenditures for 1934 were only approximately 50 percent of what they were during a few years ago. Our school building program is going to call for an increased expenditure. We must build not only new schools to accommodate the larger enrolments of today, but also to replace buildings no longer suited to their purpose.

Linn (687) pointed out many economies that can be practiced in construction. He set up definite criteria concerning: (a) building alterations and additions, (b) school building surveys, (c) the selection and purchase of school building sites, (d) the selection of the architect, (e) the importance of the educational adviser in the school building program, (f) state participation in local school building programs, (g) the awarding of the contract, (h) the supervision of the building during construction, (i) waste in school building plans, (j) waste in mechanical equipment, and (k) the educational equipment.

Summary

While the actual amount of research completed during the past few years that would indicate trends in schoolhouse planning is rather limited, the writings of school administrators, architects, and educational specialists indicate much thought and interest in the problem. Important changes are now taking place from the old traditional school to one that will be largely devoted to the problem of assisting the boys and girls to become better acquainted with their environment. Such a changed conception necessitates marked changes in the function of the entire school plant. No longer can the school be a place where the children sit quietly for five or six hours per day. The school must become a dynamic institution assisting dynamic personalities to become more wholesomely integrated with their environment. Some of the distinct trends revealed as desirable by the current literature on school-plant planning are:

1. The curriculum needs of a community determining the school plant program
2. A larger and better equipped school plant
3. An increased participation of professional educators in the planning and the execution of the school planning program
4. A more flexible and expansible school plant
5. An increased interest in national planning which has developed rapidly during the past five years
6. An increased interest in state and regional planning
7. The development of community planning
8. The local superintendent of schools assuming the responsibility in the management of the school-plant planning program
9. The construction of a more durable school plant
10. The functional use of the school plant
11. The adaptation of the school plant to serve the social, recreational, and educational needs of the community
12. The development of a simple but dignified type of architecture

13. A more efficient utilization of the school plant

14. The use of a comprehensive school survey as the basis for determining the school plant needs.

15. The wider use of the pay-as-you-go plan for financing the school-plant planning program

16. The development of a low open type of school building

17. A change in the kinds and types of equipment used

18. The expenditure of a decreasing percent of the total school budget for capital outlay.

CHAPTER X

Needed Research in the Field of School Buildings and Equipment

EDUCATIONAL RESEARCH has made many contributions to the efficiency and economy of practically every phase of education. The curriculum, methods of teaching, administrative procedures, and finance owe much to the findings of research studies. It is therefore surprising to find that so little real research has been done in the field of school buildings and physical equipment. The explanation may lie in the fact that in the past, and to a great extent at present, the process of education has been largely a sitting-at-a-desk one with the major emphasis on textbook study. As a result, buildings and equipment facilities were given slight consideration. The broadening curriculum, the more active methods of learning, and emphasis upon doing and working with things rather than merely studying books—all have focused attention upon the importance of the physical environment and the supply of materials necessary for this changed type of work.

From the standpoint of cost, it would seem that the school plant and its equipment would have attracted careful study. Table 10 gives some interesting data showing the total expenditures of all states for public education and expenditures for lands, buildings, and equipment.

TABLE 10.—TOTAL EXPENDITURES OF ALL STATES FOR PUBLIC EDUCATION AND FOR LANDS, BUILDINGS, AND EQUIPMENT, ALTERNATE YEARS, 1920–32 (714)

Year	Total school expenditures, including capital outlay and debt service	Expenditures for lands, buildings, and equipment	Percent of total spent for lands, buildings, and equipment
1920	$1,036,151,209	$153,542,852	14.8
1922	1,580,671,296	305,940,965	19.35
1924	1,820,743,936	388,469,143	21.3
1926	2,026,308,190	411,037,774	20.3
1928	2,184,336,638	362,996,156	16.6
1930	2,316,790,384	370,877,969	16.0
1932	2,161,170,060	210,996,262	9.8
Total for seven years	$13,126,171,713	$2,203,861,121	16.8

The table does not include interest payments which in the one year 1932 amounted to $182,943,930, or 8.5 percent of the total expenditures for all purposes during that year. It will be noted that the percent of the total expenditures for public schools spent for lands, buildings, and equipment since 1920 ranges from 9.8 in the depression year 1932 up to 21.3 in 1924. If interest charges which are rightfully a capital outlay charge were included for the period covered in the table, then approximately 25 percent of the total cost of public education in the United States is devoted to capital outlay and interest charges. Assuming similar expenditures for school plants in the odd numbered years, that is, 1921, 1923, etc., approximately four and a half billions of dollars have been spent on school plants in this country between 1920 and 1932, and yet comparatively little attention has been given to research study of this tremendous educational outlay.

In the National Survey of School Finance (715), the following comment was made:

> Next to the expenditures for teachers' salaries, the expenditure for capital outlay is the largest single item in school cost. It is generally believed that much money is being wasted in the expenditures for capital outlay. . . . Some of the larger and more palatial school buildings today cost several hundred thousand or several million dollars, and thousands of dollars can easily be wasted in the planning and construction of only one building. For example, if one unnecessary classroom were constructed in a building, there would be a waste of several thousand dollars. . . .
>
> There are several criteria which school officials must keep in mind in selecting school sites. These criteria are based largely on opinion rather than on research; the size of the school site, for example, is still a matter of opinion, as are other criteria. . . .
>
> Because of the enormity and technical nature of the problem of planning, constructing and financing school buildings, there are numerous opportunities for waste. Research should be undertaken looking toward the elimination of as many wastes as possible.

In a report prepared by the United States Office of Education for the Citizens Conference on the Crisis in Education (712) are found the following statements:

> The addition of new schoolrooms to house the increasing school population is being postponed during this (depression) period. Long-time building programs are being held up, and eventually enormous expenditures will have to be undertaken to bring the available housing up to the demands. In many localities, school buildings which are unsanitary and otherwise dangerous to child health and safety must continue in use. In other localities, it means that the types of instruction required to meet the changing needs of society cannot be met because of unsuitable school plants.

Comments from two men, both thoroughly familiar with the school building field, are pertinent here. Dr. H. W. Anderson, superintendent of schools at Omaha, Nebraska, and formerly responsible for the development of the school building program in Denver and Detroit, was a member of the committee which prepared the first number of the *Review of Educational Research* in the school building field. In a communication in connection with his work on this committee, he wrote, "Actual research in this field almost entirely lacking." The second comment is taken from a letter from Francis Scherer, superintendent of school buildings, Rochester, New York, who has prepared Chapter VII of this issue of the *Review of Educational Research* dealing with "Types of Construction and Materials as Related to the Original Cost, Maintenance, and Operation of School Buildings." Quoted from this letter is the following:

> You will notice that it (Mr. Scherer's section) does not follow the style of the matter in some of previous *Reviews* which is due entirely to the fact that my assignment was such that reference to published works was almost impossible because of a lack of writings on the subject.
>
> I have reviewed countless numbers of *School Board Journals* and *Nation's Schools,* together with various architectural and engineering magazine articles, but I could not get enough information to justify a bibliographical set-up.

Another member of the committee, W. K. Wilson, writing about his chapter dealing with technics for determining housing requirements in elementary schools and junior and senior high schools, commented in part as follows:

> But nevertheless I managed to go through a lot of material, then made a complete digest of Smith's four volumes of bibliography from Indiana. Of the nearly 5,000 references in Smith's work, I isolated eleven which can properly be called research into that phase of school building problems dealing with planning of buildings. Only three of these dealt specifically with planning techniques. . . . I think I could write an interesting chapter on the need for further research along that line.

The earlier statement that "the types of instruction required to meet the changing needs of society cannot be met because of unsuitable school plants" is significant as an indication of the importance of the school plant to the efficiency of the educational program. Is the money spent for a modern school building justified or would a cheaper and less elaborate building do just as well? How important is the school plant to the school program, and in what features and to what extent does a building and equipment affect the efficiency of teaching? There is at present no adequate answer to these questions.

Perhaps most people would agree that there is a relationship between the quality of the school plant and the character of the educational program, but little evidence of this relationship is available. Some evidence of this relationship was found by Holy (713). In this study, 7,067 of the 7,116 public school buildings in West Virginia were distributed by type of construction in accordance with the classification of the American Institute of Architects. This classification of five types extends from Type A which includes buildings constructed entirely of fire-resistive material, to Type E which includes frame buildings. Quoted from this study is the following:

> In the total educational process the school buildings, of course, are only one factor. There may be found, and probably are, many good schools operated in poor buildings and vice versa, but on the whole it seems a safe assumption that there is a direct relationship between the quality of school and type of building. Fortunately it is possible to get some objective measure of this relationship so far as the state of West Virginia is concerned. Mr. E. L. Bowman, Statistician of the State Department of Education, recently rated the fifty-five counties of the state according to the Ayres method. . . .
>
> This relationship is rather strikingly shown in certain specific cases. For example, Ohio County, which ranks second on the basis of the few E class buildings found therein, ranks first according to the Ayres method. On the other hand, Pendleton County, which according to the above table had only E class buildings, ranks 55 or

lowest among the counties. In order to get this relationship for the entire group, the ranking by counties according to the Ayres method was correlated with the ranking on the number of E class buildings, with the county having the smallest number of E class buildings ranking first. This correlation ran + .66 with a probable error of + or — .0530. In view of the type of measurements used, this is a very significant relationship.

Obviously no general conclusions can be drawn from this relationship because there are many other factors in this situation which were not under control. Furthermore, items 6 to 9 of the Ayres Index are measures of expenditures for other than salary purposes, including those for buildings. Such being the case, there is a common factor which may in part be responsible for the relatively high correlation. Despite that, however, the facts indicate a positive relationship, the extent and character of which need further investigation.

Aside from mere opinion, no one knows how a school building or its equipment may best facilitate the activities of the school. There are a number of school building "standards" and "score cards" which have undoubtedly contributed to the improvement of buildings, but these standards are usually formulations derived largely from opinions rather than research.

It would be impossible to present here all the needed research in this field but as an indication of some of the problems needing careful study, a few are listed.

In general the problems in the school plant field may be divided into two major divisions:

First—Those problems concerned with the functional planning of school buildings and equipment to serve better the actual instructional and recreational activities of the school.

Second—Financial problems concerned with the efficient and economical construction, maintenance, and operation of the school plant.

An example of the first type is that of space provisions necessary for various school activities. State regulations for classroom space per pupil vary from 10 square feet to 19 square feet. In four junior high schools in one city the number of square feet provided for each pupil in science rooms varies from 28 to 91, in shops from 53 to 85, and in gymnasiums from 65 to 86. If 10 square feet per pupil in a classroom is sufficient, then to require 19 square feet is a tremendous waste of money. But for lack of definite knowledge, it is generally the custom to average the extremes and pronounce approximately 15 square feet per pupil to be the desirable allotment of space for classrooms.

There is likewise little definite basis for determining the amount of space which would be allowed for non-instructional parts of the building, such as corridors, toilets, offices, storage, and similar areas. Under these conditions, it frequently occurs that some parts of a school building are much more spacious than needed while others are seriously restricted. The cost of school buildings is so great as to make such haphazard planning a serious drain upon finances.

An example of the second type of problem is that of the effect which the size of building and type of construction have upon operation and maintenance costs. Approximately 15 percent of the current expenses of the public schools in the United States, or over $250,000,000 normally go for operating and maintaining the school plant. Costs of maintenance vary among cities from 2 to 8 percent, and costs of operation from 9 to 13 percent of the total current expenditures. These wide differences are probably due to the type, size, and age of buildings, kinds of construction, materials and equipment, and the policy of the school systems in their programs of operation and maintenance. It seems reasonable to expect that many of the factors which contribute to excessive operation and maintenance costs can be isolated and in many cases ways can be found to reduce this cost substantially, especially in buildings erected in the future.

A few additional problems needing research study will be cited merely to indicate the general nature of the unsolved problems in the field of school buildings, grounds, and equipment.

1. Reliable methods of determining the room requirements for a given program. New York state has made considerable headway in meeting this problem for its own program.
2. Size of school sites. These need to be determined on the basis of the recreational program.
3. Flexibility in the design and construction of school buildings. This problem is increasing in importance due to developments in curriculum and teaching methods. A school building has a life of 50 to 75 years and unless it is of a flexible type, it either thwarts educational development or has an early obsolescence.
4. Expansibility so planned that additions can be most easily and economically made without destroying the unity of the building.
5. Factors which contribute to obsolescence.
6. Lighting, both natural and artificial.
7. Toilet requirements.
8. Studies of building utilization.
9. Location and plans of different types of rooms.
10. Best building materials, when cost and utility are considered.
11. Multiple use of rooms and equipment.
12. Acoustics of classrooms, libraries, and auditoriums.
13. Arrangement and types of equipment.
14. Effect of good school buildings and equipment on educational achievements.
15. Methods of calculating unit costs of school buildings.
16. Effect of expenditures for capital outlay upon the school budget and upon the curriculum. This question is particularly pertinent in small communities. New buildings may furnish a stimulus to the support of an enlarged educational program or there may be a tendency to pay for the new building by savings made at the expense of teachers' salaries, supplies, or other current expenditures.
17. State and city organizations responsible for the planning, erection, maintenance, and operation of school buildings.
18. School plant insurance. Ratio between premiums and losses according to types of building construction. Self-insurance plans. Effect upon insurance rates of elimination of fire hazards.
19. Continued studies of school ventilation (see detailed suggestions on page 361).

Some explanation for the relatively meager amount of research in the field of school buildings and equipment may be the fact that such studies require unusual facilities and in many cases would necessitate a considerable outlay of time and money. It must also be recognized that the problems in this field are somewhat technical and there are not a great number of persons with the experience and training necessary to make many of the needed studies. Furthermore, many of these are engaged in administrative work and hence cannot devote the time and energy necessary to this type of research. No doubt the character of recent studies indicates that the place of adequate school plants and equipment in the modern program of education is receiving more and more attention. There is need, however, for an organized research program, adequately staffed and financed, so that there may be a continuous and consistent attack on these significant school building problems.

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REVIEW OF EDUCATIONAL RESEARCH

Official Publication of the American Educational Research Association, a department of the National Education Association.

The contents of the REVIEW are listed in the EDUCATION INDEX

Volume V **December, 1935** **Number 5**

EDUCATIONAL TESTS AND THEIR USES

(Literature reviewed to June 1, 1935)

Prepared by the Committee on Educational Tests and Their Uses: E. F. Lindquist, Paul V. Sangren, Ralph W. Tyler, Charles C. Weidemann, and W. J. Osburn, *Chairman*; with the assistance of F. P. Frutchey, Louise Mahone, and William Maucker.

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INTRODUCTION

This report is organized for the most part in accordance with the plan used in the previous issue of the *Review of Educational Research* for February, 1933, which was devoted to educational tests and their uses. One important change has been made, however. The chapter on basic considerations was replaced by a consideration of tests and measurements in several foreign countries. A precedent for this policy exists in the recent issue of the *Review of Educational Research* devoted to psychological tests. Such reviews are also quite common in foreign periodicals.

Acting upon the suggestions of many of our readers we have increased the amount of critical comment concerning the references quoted.

While there is still some overlapping among the chapters, we think we have succeeded in restricting this feature to a minimum. We trust that we have succeeded at the same time in covering the entire field in an acceptable manner.

The chairman of the Committee wishes to take this opportunity to thank the other members for their faithful cooperation. Thanks are also due to Messrs. Maucker of Iowa, Frutchey of Ohio, and Mrs. Louise Mahone of Washington for their valuable contributions to the success of this number.

W. J. Osburn, *Chairman,*
Committee on Educational Tests and Their Uses.

CHAPTER I

Educational Tests and Measurements in China, England, France, and Germany[1]

THE REPORT that follows is reasonably complete for the countries represented. Occasionally a report is also included from Holland and Poland.

A. CHINA

Tests and Measurements

In China educational experimentation is new. The Chinese have but recently thought of education as an area of specialized and professionalized learning. Furthermore, for a long time the traditional examination system has seemed sufficient without any changes of consequence in its procedure or requirements. Recent contact with other countries, however, has challenged the leadership of Chinese social, economic, cultural, and educational life to such an extent that some significant changes in the procedures of educational tests and measurements have been made. This movement began in 1922 when William A. McCall of Columbia University visited China as director of psychological research under the auspices of the Chinese National Association for the Advancement of Education. As early as 1913, and later in 1921, informal discussions on testing were conducted by such men as Liao Shih Chen, Chen Ho Ching, and Chang Yao Hsian; and in such institutions as the Higher Normal Schools of Peking and Nanking.

By 1923, many tests had been standardized, covering such fields as intelligence, silent reading, auditory comprehension, mixed Wenli and National Language, composition, formal handwriting, running handwriting, fundamentals of arithmetic, arithmetical problems, fundamentals of algebra, algebraic equations, algebraic problems, integers, decimals, general science, Chinese geography, Chinese history, household arts, citizenship, health, and the teaching of English in Chinese schools. Many of these tests were similar to those used in America. To quote McCall, "The tests . . . merit, I believe, the conclusion that in every case they are equal, and in most cases they are superior to the like tests in America."

For a few years both intelligence and achievement testing developed in almost every phase of school work, yielding such results as mental and subject ages, correlations of abilities, objective technics of testing, and comparisons by subjects among individuals, classes, and other groups. In the period just previous to 1925, the emphasis on intelligence, language, and arithmetic tests was most noticeable in the educational periodicals. There were also discussions of principles and technics of testing and measuring.

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[1] Professor Weidemann reports for China, Mrs. Mahone for France, and Professor Osburn for England and Germany.

Between 1922 and 1924, testing in the province of Kiangsi was undertaken. All of the public and private schools gave intelligence and achievement tests. Teachers became aware of pupil differences, special classes for exceptional children were proposed, and a new professional interest among teachers seemed to have been created. From 1925 to 1927, interest in the movement decreased, but from 1928 to 1930 a revival of interest was evident. Since 1930, in such municipal centers as Nanking and Shanghai, the measurement of the intelligence and achievement of students has increased. In some experimental schools established by bureaus of education in cities or districts or affiliated with teacher-training institutions, the outcomes of instruction are regularly tested and measured.

Educational Research Organizations

Many institutions engage in some kind of educational research. In the normal schools, colleges of education, and departments of education in the universities, the teachers carry on research and collaborate with advanced students. In the College of Education of Central National University at Nanking, Professor Hi Wei has published a series of reports on research findings which exemplify educational research in such institutions.

The best known organizations covering the general phases of educational developments in China are: the Chinese National Association for the Advancement of Education, the National Association for Mass Education, the National Vocational Education Association, and the Chinese National Education Association. Each of these bodies has published materials, chiefly of a statistical and survey character, relative to many different phases of Chinese education.

Some educational research has been done in such provinces as Kiangsi and Shantung, and in such municipalities as Nanking and Shanghai. At Pin-Yang and Chow Ping some educational social experiments have been conducted.

Since 1928, the Institute of Educational Research at National Sun Yat Sen University in Canton has been trying to devote its entire program to educational research of a scientific character and to assemble a collection of literature essential to such research. The productions of this institute include studies for the improvement of teaching Chinese, the discovery of better methods and contents for adult education, and the relationship between education and the economic life of the Chinese people. This institute also publishes the *Chinese Journal of Educational Research* and a series of research monographs. Its assembled references include an eight volume *Index to Chinese Educational Periodicals* and 34,000 volumes in Chinese and other languages consisting of books, magazines, reference books, documents, research bulletins, and school textbooks (12).

Sample References to Recent Educational Research

Through the representative of the Chinese Ministry of Education, Mr. Wei Hsueh-Chih, a number of recent documents of an experimental nature have been received (see bibliography). Mr. Chih's statement indicates that through Dr. H. H. Hsiao of the Society of Tests and Measurements at Nanking, an authority on educational research in China, much information may be obtained. The documents received are in Chinese. Many efforts were made to secure their translation, but no person was available who judged himself capable of translating the technical vocabulary. The references indicate something of the nature of the studies, but no evaluation of their content was possible.

Summary

The above description indicates that Chinese educational leaders are developing tests, measurements, and experimentation for Chinese boys and girls. They have established a basis for such development, have succeeded to the point where whole provinces have used educational tests, have started to develop their own institutions adapted to solve Chinese problems, and have begun a movement toward education as a profession. Chinese and American educators should exchange educational research literature in order to further international goodwill and humanitarianism.

B. ENGLAND, FRANCE, AND GERMANY

Educational tests and measurements have developed much further in the United States than they have in Europe. From the European point of view our growth has been too extensive. European thought tends to be organismic and configurational in character. There is little sympathy for our atomism in psychology or pragmatism in philosophy. Educational tests do not thrive where elements or "atoms" are neglected. Pragmatism, with its insistence that anything is good if it works, encourages the growth of educational tests as a means of ascertaining to what extent our desired outcomes have been achieved. In Europe there is little or no emphasis upon educational outcomes as we know them.

Whatever the complete explanation may be, the fact remains that European countries have not shown a marked interest in tests for general use in schools. No large publishing concerns in Europe devote a major portion of their attention to the publication of educational tests and measurements. On the other hand it would be erroneous to state that Europe is not interested in educational tests. Numerous workers in England, France, and Germany are using them for research purposes.

Everywhere during recent years a remarkable interest in intelligence testing has developed. References to intelligence testing were collected through error in gathering the data which relate to France. Rather than lose the results of the work the references are included. All other articles relating *exclusively* to psychological tests were excluded. In many cases, however, foreign authors make no clear distinction between psychological and educational tests. This will account for several citations that are apparently psychological in nature but which nevertheless devote considerable attention to tests and statistical procedures of an educational type. For this reason a few references are included which occur also in the June, 1935, issue of the *Review of Educational Research* relating to psychological tests.

Criticism of Testing

Since the testing movement is questioned in Europe, one would expect to find many articles of a critical nature. There are a few. Juhasi (87) discussed the effect of the organismic movement on testing. Szondi (185) reported a critical and historical study of psychological tests which is applicable to educational tests as well. Thomson (191) would replace intelligence quotients with standard scores.

Another sort of criticism is directed at the American testing movement as such. Duthil (48) likes what we are doing. Leitzmann (106) also offered favorable comment. He wonders "why we [in Germany] have so long overlooked the achievement tests and the rich literature that goes with them." He then offers these reasons. In general, Germany has paid little attention to investigations in other lands. The great war and the years of inflation following it have interfered. There is an attitude of "What can America, the land of practicality and pragmatism tell to us, the very authors of pedagogy?" The author quotes William Stern to the effect that our tests are too mechanical and that they are the product of a "test-cult." Leitzmann then proceeds to quote several of Counts' adverse criticisms of tests but offers nothing in rebuttal. He sees a contradiction in our claim that every child is unique and test construction based on central tendencies. In spite of all adverse criticism, the author concluded that Germany can gain from educational tests "much valuable help in formulating more objective and useful judgments."

Statistical Procedure

There is much interest in statistical procedures related to testing. Blumenfield (20) gave an interesting mathematical treatment of test evaluation. Bobertag (22) has a rather elementary discussion of statistics for his readers in Germany. Dwelshauvers (57), Meili (115), and Spearman (178, 179) presented discussions concerning the G factor. Emmett (64) and Wilson (202, 203) were concerned with the tetrad criterion for use in scholastic examinations. The point at issue was the G factor. Fessard (71), Levitof (103), and Valentine and Emmett (197) were interested in reliability. Statistical phases of test standardization were discussed by Fessard and Piéron (68), and Mme. H. Piéron (147, 148). Kern and Lindow (89) and Lipmann (108) reported discussions of curves and curve fitting. The applications of the theory of probability were presented and criticized by Moers (120), Myers (127), Poppelreuter (151), and Thouless (193). Pauli and Wenzl (134) presented a "very simple method for the calculation of coefficients of correlation." They suggested the formula $R = \frac{M_1 - M_2}{M_1^1 - M_2^1}$ in which the M's represent the means of the upper and lower halves respectively of each distribution. Rosenblum (161) developed a method of testing homogeneity among test items. Thumb (194) presented clearly the theory and technic of multiple correlation applied to the weighting of test items. He suggested the use of polar coordinates which he illustrated with interesting geometrical figures. Urban (195, 196) wrote a series of articles on methods.

Test Batteries

Ten articles were concerned with test batteries. Ballard (17) is clearly the most influential author of educational tests in the countries covered by this report. His tests are available for commercial use and are commanding attention in both France and Germany. Decroly (37, 38, 39, 40) used them in Belgium and they have been used in Germany. Duthil (51, 55) published a manual for the use of intelligence, achievement, and aptitude tests. Sandon (167) reviewed a secondary-school test prepared by Brockington. Rather elementary discussions of testing methods were presented by Duthil (51, 54, 56), Frickx (77), Nihard (130), K. Stern (182), and W. Stern (183).

Tests as Survey Instruments

A number of articles were concerned with the use of tests for survey purposes. Bartsch (18) compared the achievement of pupils in two types of German schools. His tests were designed to measure concentration of attention, interpretation of familiar pictures, the combination of meaningless figures, the power of imagination with reference to given pictures, the power of observation, and forgetfulness. Bartsch used the profile technic but failed to describe his tests. Bobertag (23) compared estimates and measurements of achievement in the German folk schools. He showed that measurements are much more reliable. Bobertag is one of the few German investigators who has the American point of view concerning tests. A series of articles covered a study of achievement in certain schools of college rank in Germany (83). The authors were interested in the stage of knowledge attained by pupils of different intellectual and social levels. They agreed that "testing procedure is looked upon as an American effort toward rationalization and tends to become the single ideal toward which the human soul strives," but they could not forget the "very critical condition of the 'Hoch-Schule' studies and their immense defects." The authors expected their studies to be criticized as "grab and snatch" procedures. They defended them not as individually diagnostic but as a "statistical method of searching after knowledge." The experiment involved 1,143 subjects and many assistants. The tests covered such items as power of observation and description, the understanding of textbook content, and the command of a foreign language to be chosen by the subject. The tests of observation and description contained pictures of skulls half human and half chimpanzee or ape. The criterion was a description written by an expert describer of skulls. The test conditions were carefully controlled in all cases.

The authors were much interested in sex differences. When the girls did not do as well as the boys the cause was ascribed to "the greater sensitivity of the woman." In some cases the girls excelled the boys. Concerning this result the authors say: "An explanation of this fact is naturally difficult to give. One might point to the well-known psychological fact that the female sex is inclined to be, for the most part, more frivolous, more eager for praise, more diligent and quite devoted to details and minutiæ." When the girls excel, the authors simply cannot understand it or reconcile themselves to it.

In both the English and French examinations the content was a discussion of M. Briand's reply to Mr. Kellogg concerning the outlawry of war. Reference is made to the isolationist scruples of America. A portion of the text reads as follows: "Whatever happens and whatever the other struggles in which France may find herself involved, she can rely, at worst, on American neutrality." Great care was taken throughout the experiment and much attention was devoted to errors. The articles have much to say concerning the difficulties encountered in evaluating answers.

Huth (84) used modified forms of tests prepared by Bobertag and Hylla with different time limits. He was interested in attention, application to details and to relations, association, command of language, discrimination of space relations, concepts of order, ability to make analogies, and ability in mathematical and organized thinking. Attention was also devoted to such items as interest in work, understanding of work, carefulness, and sobriety.

A test battery published by Bobertag consists of six parts, two of which are devoted to reading, two to arithmetic, one to language, and one to spelling (101). The tests may be purchased at one mark per copy from the Zentralinstitut für Erziehung und Unterricht, Berlin W 35 Potsdamer Strasze 120. This is the only instance noted of tests published in Germany for commercial use.

Müller (124) reported a survey of the relation between school performance and social influences. School performance was measured in terms of teachers' estimates. Weigl (199) listed 790 pupils with reference to logical thinking, spatial discrimination, and power of attention. The occasion for the tests was the passage of the pupils from a lower to a higher school.

Tests of School Subjects

Arithmetic—Tests were reported for eight individual school subjects. Arithmetic leads with eight articles. Burt (30) and Duthil (50) reported tests that are available commercially. Korn (91) presented a study of performance and error in calculation. Lindbeck (107) was interested in the work curve of school children. The task was to complete sums in which the digit in the ten's place had been omitted. Rate was measured by having the children work where they were at the end of each time interval. Work curves of individual pupils were shown along with the curve for the entire class. Deviations were interpreted in terms of temperament, intelligence, emotionality, and interest. Experimentation of this sort would be helpful in America.

Révész (157) reported a study of arithmetical achievement and skill in the highest levels of the primary school (sixth grade). The study was carried on in 19 schools of the city of Amsterdam. The tests were a modification of the Ballard tests. They comprised in part 100 abstract examples and 100 problems. The pupils' papers were examined for errors and the types of errors were reported. In problem-solving, hoaxes were introduced such as the following:

1. A boy has to walk 3 kilometers to get to school. He can ride four times as fast on his bicycle as he can walk. How far must he ride on his bicycle to reach school?
2. A man can go from his home to the depot in 20 minutes. His son likewise can make the same journey in 20 minutes. How many minutes will it take them if they go together?
3. If it takes 3 minutes to boil an egg how many minutes will it take if there are ten eggs in the water?

Nearly 60 percent of the pupils failed to see these hoaxes. Only 7½ percent of the pupils could solve correctly time and space problems such as, "My watch gains 4 minutes a day. If I set it right at noon Monday, what time will it be the middle of next week when it is 6 P. M. by the right time?"

Only 16½ percent filled out correctly "The minute hand goes ——— times as fast as the hour hand." Twenty-eight percent solved, "A thirty-five-year-old man is 7 times as old as his son. How many times as old as his son will the father be in 25 years?" The problem "A man walks 6 kilometers per hour from B. Two hours later another man starts after him on a bicycle and rides at the rate of 10 kilometers per hour. How long must the bicyclist ride to overtake the man who is walking?" was solved correctly by 15.6 percent of the children.

Thirty-five percent of the children correctly solved, "A man goes 5 miles north, then 5 miles east, then 5 miles south, then 5 miles west. How far is he then from where he started?" Only 10 percent solved correctly, "Along a 90 meter street there were trees standing from beginning to end on both sides, 6 meters apart. How many trees stood along the street?"

The following are listed as easy examples that first-year pupils ought to solve. The percents following in each case indicate how many pupils really solved them.

1. There are 40 nuts in a saucer. After 5 men have eaten 7 nuts each, how many nuts will remain in the saucer?—50.3 percent.

2. A boy measured a rope with a meter-stick and found that it was 6 meters long. But someone had secretly cut off one centimeter from the meter-stick. How long was the rope actually?—31.5 percent.

3. If 1½ kilograms of cocoa costs 3 RM. (reichs marks) how much does one kilogram cost?—83 percent.

4. I divided five marks between two girls. One got 1½ times as much as the other. How much did the girl get who got most?—53.1 percent.

5. How many apples can I buy for 1.20 RM. at the rate of 4 for 15 pennies? (one RM. equals 2½ pennies)—22.9 percent.

6. A band box and the key for it cost together 2.20 RM. The box cost 2 RM. more than the key. How much did the key cost?—77 percent.

Like many other investigators the author speaks of the errors as being surprising and almost unintelligible.

As in America, many children failed to read all of their problems. This error caused 47.3 percent of the pupils to fail on the problem, "The foot of a hill is 200 meters above sea level. The top of the hill is 400 meters above sea level. How far above sea level is a house that stands half-way up the hill?"

Inexperience with space relations caused trouble with the following problems. The percents show the number of correct solutions.

1. We have 60 centimeters of iron wire. Out of it we make five triangles of equal size and equal sides. How long is each side of such a triangle?—56.7 percent.

2. A rectangle is twice as long as it is broad. Its area is 200 square decimeters. How long is it?—23.4 percent.

3. Around a rectangular flower bed 3 meters long and 2 meters wide there is a grass fringe ½ meter wide. What is the area of the fringe?—10.3 percent.

4. The outside dimensions of a rectangular mirror are 15 decimeters long and 8 decimeters wide. The mirror has a frame 1½ decimeters wide. What is the area of the mirror inside of the frame?—26.5 percent.

The tests also included material designed to test mathematical understanding and insight.

Schmidberger (169) used arithmetical exercises with 1,121 boys and 1,163 girls in and about Jena to test sex differences. Seemann (170) presented an extensive study of the psychology of number and of errors in calculation. This is in all probability the most complete study of errors with whole numbers that has been published in any language. The author classified errors as mechanical, associative, and functional. Mechanical errors were interpreted as usual. Associative errors were due to similarity of sound, similarity of figure, and perseveration. Functional errors were those of operation, logic, and harmful transfer. The author concluded that errors are never accidental. He gave a very detailed presentation of errors in the four fundamental processes.

E. Thomson (194, 189) used arithmetic exercises as a part of a battery of tests to study the efficiency of individual work.

Spelling—Six references relate to the testing of spelling. Brandicourt (27) used tests which require the subject to write the proper names under drawings. Duthil (49, 56) discussed methods of testing spelling. The results of tests in spelling were reported by E. Thomson (189).

Language—Four articles were found which dealt with language testing. Duthil (53) was concerned with the measurement of ability in composition. Williams (201) reviewed the North Hampton Composition Scale. Bobertag has a language test (101).

Reading—Four studies are also presented which involve the testing of reading. K. Stern (182) was interested in beginning reading. E. Thomson (189) reported results with Haggerty's reading tests. Thorner (192) presented a rather extensive study of the psychology of reading. The content of the test was partly sense and partly nonsense material. Reading difficulties were treated in terms of size of type, vocabulary, length of words, and word form. The data were collected by means of the tachistoscope.

Miscellaneous—Bradford (26) presented a study of perspective in geography. Eaglesham (58) used content relating to the geography of Australia in studying retention. Eggink and Bradford (60) presented further arguments concerning the testing of perspective in geography. Fessard and Fessard (72) discussed musical aptitude as shown by the Seashore records. Mainwaring (111) presented his tests of musical ability. Simon (175) presented a discussion of group tests in drawing. Theiss (188) tested the relation of handwriting to the character of the writer. Leopold (102) presented tests of the appreciation of poetry. Brandicourt (27) tested vocabulary. Robson (159) presented a study of vocabulary burden in the first year of French study. She reported that "children with an average age of about 12 and who spend two hours weekly at French are able to deal with a vocabulary of from 450 to 812 words during the first year. Within this range they succeed in correctly recognizing an average of 71% of the words presented but can actually reproduce only 58% of them." The study is both extensive and thorough.

Examinations and Marks

There is considerable interest in the form of examinations. Champneys (32) presented a bibliography of studies relating to the English examination system. Emmett (64), G. Thomson (190), and Wilson (202, 203) were concerned with a tetrad criterion for use in examinations. Farmer (65) presented data on the predictive value of examinations. Kesselring (90) has a study of entrance examinations, especially for teacher-training institutions. He investigated the possibility of substituting newer test forms for the present state examination in Germany. He suggested tests of memory, attention, and the higher intellectual processes. He presented in detail the nature of the tests that he would have used. He recommended that new tests be used instead of the present examinations. Valentine and Emmett (197) were concerned with the reliability of examinations. Piéron (138) and Sandon (165) presented criticism of examination methods.

Relatively little is being written concerning the use of teachers' marks in testing. Braun (28) and Sandon (166) based their studies on teachers' marks. Sandon (164) also presented a study of marking systems.

Aptitude and Character

Tests of aptitude are not within the range of this number, yet it seems desirable to call the reader's attention to a few studies in that field. Claparède (33) has a book on discovering aptitude among school pupils, and De Montlebert (45) on determining aptitude by tests. Duthil (51) also presented a study of tests of aptitude. Fessard and Fessard (72) were interested in musical aptitude. Fessard (70) discussed the interpretation of numerical results in aptitude examinations. Lahy (97) reported results obtained with the Stenquist Test of Mechanical Aptitude. Mennens (117) has a study of mental aptitude among prisoners.

Some interest has been shown in tests of moral character. Ekenberg (61) presented a review of the character tests published in America, France, and Germany. Henning (82) presented new apparatus and methods for use in testing character. Moers (120, 121) developed tests of moral understanding, and Reynier (158), tests of character.

Physical Tests

There was also interest in tests of movement. Liefmann (104) studied the relation between mental and bodily achievement. Her tests of physical performance include such activities as stringing beads, rope climbing, balancing, rowing, jumping, and tests of suppleness, speed, and muscular strength in arms and legs. Most of these tests were adapted from those of Serebrowskoja (172, 173) of Moscow. Stephenson (181) was interested in tests of motor perseveration.

Diagnosis, Prognosis, and School Readiness

Quite a number of workers claimed diagnostic value for their productions. Brandicourt (27) presented drawings as a basis of diagnosis. Claparède (33) has much to say on the subject. Kovarsky (92, 93, 94, 95, 96) described the use of the psychological profile for diagnostic purposes. Rohrschach (160) discussed the methods and results of psychological diagnosis.

Only three workers made claims as to tests having prognostic values. Bobertag (21) and Lietzmann (105) discussed the comparative prognostic value of tests and school reports. Farmer (65) studied the "predictive value of examinations and psychological tests in skilled trades."

Tests of school readiness are usually of the mental type. Descriptions of a few of them by Bühler and Hetzer (29), Remy (155), Winkler (204), and others (187) are noted here as samples.

Orientation and Social Participation

The use of tests for orientation and guidance has attracted some attention abroad. Ménessier (116) described the use of tests of professional orientation. Similar discussions were presented by the Piérons (139, 144, 147).

Saluschny (163) reported an interesting study of the measurement of social participation among groups of school children. The experiment was carried on in Charkow, Ukraine. The tests consisted of eight tasks. Groups were required to choose a representative to participate in the school conference of the city. They were also asked to choose a director for the arrangement of the schoolroom, to sketch a plan for community work, such as a school picnic or excursion, to select the pupils best suited for each duty, and to pick out the five members of the group who in the opinion of the group exercise the most disorganizing influence. The plan of scoring is explained. The coefficients of reliability ran as high as .98 ± .006. The test was given to 8,000 children.

Psychological Tests

Owing to their organismic views it is natural to expect foreign workers to use psychological tests for educational purposes. Abadi (15) reported a test of personality. Abrahamson (16) and Bartsch (18) presented tests of imagination. Abrahamson (16), Bartsch (18), and Monchamps (122) were concerned with tests of observation. Bartsch (18), Gamsa and Salkind (79), Mme. Piéron (146), and Weigl (199) reported tests of attention. Bartsch (18), Fischler and Ullert (73), Mme. Piéron (147, 149), and Kesselring (90) used tests of memory. Dilger (46) discussed classification by means of the Gaussian curve. Eder (59) undertook the diagnosis of carelessness. He assumed that LM=SM times K. Where LM is the best possible performance of an individual, SM is the worst possible, and K is carefulness. Letting LN equal the performance under normal conditions and substituting, the author arrives at the formula LN=SN times K. He considered $\frac{\text{LM}}{\text{LN}}$ as a carefulness quotient. It is interesting to note that the author's assumptions are related as factors in a product rather than as addends.

Kennedy (88) found that the Downey Will Temperament tests had low reliability. Mira (119) reported a new test for the exploration of affectivity. Mme. Piéron (145) described what she called psychotechnical researches in the school.

Perseveration—Cattell (31) reported p-tests of perseveration. Rangachar (154) tested perseveration among English and Jewish boys. The advantage was with the Jews. Stephenson (181) described tests of perseveration and offered extended discussion of the p-factor.

Fatigue—Foucault (76) wrote on mental work and fatigue. Lindbeck (107) treated work in written calculation in terms of work curves.

Practice—Lämmermann (99) reported a study of the practice effect upon intelligence scores. He obtained practice quotients by dividing end performance by initial performance. His quotients ranged from .63 to 1.26. He found the practice effect so marked as to cast serious doubt upon the diagnostic value of the tests. Kern and Lindow (89) presented a mathematical treatment of practice curves. They used the technic of curve-fitting and derived $y = a \log x + b$, as the general equation for practice. They described the calculation of the constants a and b.

Reasoning—Müller (125, 126) made extensive and careful studies of reasoning among school children. The subjects were aged from six to eighteen. They were required to complete syllogisms by supplying conclusions. The syllogisms contained space, time, larger-smaller, equivalent, whole-part, genus-species, symbolical (algebraic), negative, hypothetical, disjunctive, and causal relations. Individual reactions to the syllogisms were recorded and age norms were derived. These articles are of interest to all who are concerned with the task of teaching children to think.

Weigl (199) used tests of logical thinking. The tests of arithmetical reasoning by Révész (157) have been described previously under arithmetic tests.

Selection of pupils—Considerable interest was shown in the use of tests for purposes of selection. Emery (63) dealt with the social value of selection. Peyraube (136) discussed German methods of school selection. Schlotte (168) reported tests for the selection of the poorly talented. Wellens (200) discussed the selection of the élite.

Summary

The purpose of this chapter has been to supply information concerning the uses of tests and measurements in China, England, France, and Germany. There is plenty of evidence to show that educational tests are in process of development in China. The Chinese movement is the result of American influence.

The tests of England, France, and Germany have also been stimulated in part by American influence, but they also show a point of view distinctly their own. In England, statistics is still a dominant interest. France is interested chiefly in intelligence tests, while Germany has specialized in aptitude testing. In Europe educational tests are used for the most part as aids in research. Many of the foreign studies are more extensive and thorough than those in this country. American workers can derive much benefit by familiarizing themselves with the methods and point of view of their fellow workers in foreign countries.

CHAPTER II

Present Tendencies in the Uses of Educational Measurements

THAT THE TESTING MOVEMENT of this country has experienced phenomenal growth since 1900 is now the common knowledge of all educators. A study of this growth shows a fortunate decline recently in the output of materials for which, in many instances, the motive was to share in the commercial returns of an innovation. The testing movement is now entering upon a period of slower but much more significant and substantial growth. The tests published and the uses to which they are being put are the result of more precise and detailed investigation. Valuable experimentation involving the construction and use of tests is being conducted. Testing, removed from the mysterious category in which it was formerly placed by conservative educators and laymen alike, is coming to be regarded as an integral part of any educational program. There are those, of course, who look with skepticism at some of the applications of tests, but on the whole, tests and testing continue to flourish. The testing movement has made and continues to make lasting contributions to education at all levels.

Perhaps one of the main reasons for this very wholesome attitude toward measurement is that proposed by Lincoln and Workman (232). They say that, at first, testing was largely for the expert, since he alone knew the field, but now tests are devised for use and interpretation by teachers. Many books written in non-technical language are available on educational measurements, and teacher-training institutions deal with them as a regular part of the curriculum. Such textbooks on supervision as those by Burton (210), Carpenter and Rufi (211), Garrison (221), Monroe and Streitz (240), and others include testing as an orthodox procedure in instruction. Other texts such as those by Brueckner and Melby (209), M. Monroe (239), and Gates (222) make all remedial instruction absolutely dependent upon testing. Some of the larger cities maintain bureaus of research whose primary purpose is to deal with problems of measurement.

One may well wonder in what direction we are going and demand proof that tests and testing are valuable and becoming indispensable. An excellent discussion of the "pros" and "cons" of testing in the social studies which may well be applied generally was presented by Kelley and Krey (230). The discussion dealt with such topics as the relationship of testing and instruction, intelligence tests and homogeneous grouping, reliability and validity of measuring instruments, function and limitation of different types of tests, aspects of instruction and achievement measured by objective tests, relationship between objective tests and important aspects of education, relationship between individual differences and tests in the social studies, experimental method, and use of tests for appraisal in educational guidance and vocational counselling.

Along with the "slower but surer" progress of testing has come the analytical criticism of specialists in the field who realize that testing is not a cure-all. McConn (235) suggested that one of the reasons why educators have thus far failed to make continued and systematic use of tests is that there is a lack of comparable forms of examinations. The Cooperative Test Service is seeking to meet this criticism. McConn (234, 236) further criticized the much-repeated error "of assuming that results of any single examination or single set of examinations can be regarded as definite, conclusive, and valid as bases for crucial administrative action or crucial administrative advisement." Wood (268:6), in an article on basic considerations in educational testing, stated that "the chief defect in the testing movement has been the neglect of building an adequate philosophy and system of using test results for effective and constructive educational guidance in the largest sense of that word." Limitations and criticisms of mental testing suggested by Horn (227) include such statements as the following: (a) the movement is still in a formative stage; (b) mental ability is still too exclusively ascribed to determined forces; (c) misconceptions exist concerning the degree to which intelligence, as measured by tests, enters into achievement; (d) it is becoming increasingly evident that the prognosis of scholarly achievement may be better accomplished by special aptitude and achievement tests which concentrate on defined areas of subjectmatter; and (e) it is too often forgotten that there are areas of personality and social achievement in which the ingredients are not limited to intelligence. Concerning objective tests, Horn's chief criticism dealt with the placing of a premium on rote learning and a consequent failure to measure the higher thought processes. However, he stated further that "there is no evidence that these defects are peculiarly characteristic of objective tests" and that "the objective examination is demonstrably superior to the traditional examination."

State and National Testing Programs

Serving as conclusive evidence of the growth of the importance of measurement in education are the state and national testing programs which exist at the present time.

A study by the United States Office of Education (255) showed that in 1933 there were state testing programs in twenty-three states of the Union. Segel (253) described one which is especially worthy of note—the academic contest carried on in Iowa and sponsored by the University of Iowa. All schools are invited to participate and a great many of them do. Each school entering on a competitive basis agrees to give the tests to all students taking the subjects listed. The papers are scored by the schools and sent to the contest director who sends back reports which enable each school to compare its results with those of other schools as well as to compare its own pupils with each other. These test results are also used to determine school marks, to guide individuals, and to ascertain the general level of attainment. Most of the state testing programs are under the direct supervision of the state university or state department of public instruction.

In the bulletin of the Office of Education (255) referred to above and in a study by Chase (215) the following organizations are listed as conducting national testing programs: the Educational Records Bureau, the Cooperative Test Service, the College Entrance Board, Kansas Nation-Wide Every Pupil Contest, and the American Council on Education.

The Educational Records Bureau conducts an annual testing program for independent schools. Its membership has grown from twelve schools in 1927 to over two hundred at the present time. In 1933 it organized a program for public schools under the direction of a Public School Supervisory Committee. Its chief purposes are (a) to score tests and report results and (b) to act as a coordinating center for testing so that results on different tests may be comparable.

The Cooperative Test Service is an organization designed to construct tests. It has been subsidized by the General Education Board for a period of ten years to construct ten or more comparable forms of examinations in the subjectmatter of the junior and senior high-school levels. This Service cooperates with other agencies such as the Educational Records Bureau and state associations by using their tests in national and state high-school testing. For example, the state high-school testing program under the auspices of the Association of Minnesota Colleges has used the tests of the Cooperative Test Service. Tests are constructed in such subjects as the Romance languages, mathematics, science, and social science.

The College Entrance Board was made up in 1930-31 of fifty members, thirty-nine representing universities, colleges, and scientific schools, and eleven representing secondary schools. It carries on a program of testing with the graduating seniors both in the high-school academic subjects and in scholastic aptitude. These results are acceptable to all universities and colleges in the United States. A report (255) of 1932 shows that 19,929 students took one or more of these tests. The examinations are prepared by the Board itself and arrangements for giving and appointments for scoring are made by it. Committees for scoring papers are composed of representatives of many different colleges and universities and secondary schools. All work is done independently of any one institution.

The Kansas State Teachers College Bureau of Educational Measurement surpervises a nationwide scholarship test twice each year. The tests are constructed in the Kansas high schools under the direction of the Bureau. Participating schools score their own tests and send tabulations to the Bureau of Measurements which makes a report containing a national norm and the state norms.

The American Council on Education annually sponsors the construction of a new edition of the American Council Psychological Examination. The examination is widely used with high-school seniors and college freshmen. An edition has recently been constructed for use with high-school sophomores.

The Psychological Corporation has conducted a national survey of English usage which has been made a state program in Pennsylvania and Ohio.

"Cooperative" testing as such is not a recent development. Certain states conducted state high-school examinations many years before the standardized testing movement. The gain in favor of this type of testing is due to the distinct advantage it affords over the individual school testing programs. Douglass (216) listed among favorable advantages that comparable scores are available for a whole area, making possible a better understanding of achievement, and that this comparison provides motivation for pupils and teachers as well as serving as a means of classification. A further step in the direction of providing standards for comparison, reported by Segel (254), is being carried on under the supervision of the United States Office of Education in an attempt to establish equivalent scores among different intelligence tests.

Trends in Test Construction and Use

There are various methods of classification of the uses of tests. For purposes of brief review the following outline will prove helpful:

1. Prognosis
2. Surveys
3. Diagnosis and remedial treatment
4. Instruction, grouping, and marking
5. Experimentation and research
6. Guidance.

Prognosis—Some valuable contributions to measurement are made by those who would predict the success of an individual in a given field. Fritz (220) recently attempted to determine the value of certain tests for predicting college marks and teaching success. He found two tests (Aptitude Test for Elementary High-School Teachers and American Council Psycological Examination) which he considered helpful but by no means dependable in predicting college marks. He also concluded that if the Aptitude Test really measures ability to teach school, those students earning the better marks are better risks as teachers. Segel and Gerberich (252) studied the possible use of the American Council Psychological Examination in differentiating ability to do college work and ability to do work in specific subjects. They concluded that the test should not be used for differential prediction purposes when college marks are the criteria. Finch and Nemzek (219) studied the prediction of college achievement from data obtained at the beginning and end of the secondary-school period. The authors concluded that "it is quite improbable that a combination of marks from a wide variety of schools will afford a satisfactory means of predicting further achievement until marking systems are decidedly improved. The present results do demonstrate that it is possible under favorable conditions to obtain from marks assigned by high-school teachers a predictive measure of distinct value." A worthwhile evaluation of the prognostic value of different types of tests in educational psychology was made by Terry (260). The Van Wagenen Reading Scale in Educational Psychology, Form A, was compared with the Iowa Silent Reading Test and with the Otis Group Intelligence Scale in an effort to determine the relative value of the tests for predicting ability in educational psychology and in teaching. The criteria of achievement were an objective test, an essay test, and the objective and essay test combined in a single score. The subjects were the members of two classes in educational psychology attending summer school at the University of Alabama. The findings include the generalizations that (a) the Van Wagenen Test is less dependent upon the factor of intelligence than the reading tests considered; (b) there is a considerable degree of validity in the Van Wagenen Scale and it may be a better means of predicting achievement in educational psychology than tests of general reading ability; and (c) the value of the Otis Test as a means of predicting performance should not be overlooked, although a combination of the Otis and Van Wagenen yield a higher correlation with achievement than either test taken alone. A somewhat similar study was made by Torgerson and Aamodt (261) in which the purpose was to determine the validity of two aptitude tests in algebra as compared with an intelligence test. The tests chosen were the Lee Test of Algebraic Ability, the Orleans Algebra Prognosis Test, and the Otis Self-Administering Test of Mental Ability, Higher Examination. The tests were administered to 236 ninth-grade pupils in Muskegon, Michigan. All three tests were found to be about equally valid and effective in predicting grades in algebra. The aptitude tests were about equally efficient in setting up a critical score below which the students' chances for success were slight. The sharpest discrimination was made by the intelligence test, as 22 of the 23 pupils with intelligence quotients below 90 failed in algebra at the end of the year.

Another important type of prognostic test is the reading readiness test. Segel (254) said, "The problem of accurately measuring the readiness of children to read has become more important since the advent of primary curriculums which allow for considerable variation in the time for beginning reading of different pupils. These tests have been found to have scores which have a fairly respectable relationship to later achievement in reading or other first-grade school achievement." A study dealing with informational background of kindergarten children as it affects reading readiness was reported by Troxel (262). Seventy-four kindergarten children were selected according to teachers' classification of background as good or poor. Data were obtained through the health clinic, teachers' or principals' knowledge of the home, questionnaire filled in by parents, and information furnished by the visiting nurse. The summary of the study stated:

> The study of the questionnaire brings out facts which seem to confirm the importance of a rich informational background in reading readiness. The rich background children as judged by the kindergarten teachers of Kalamazoo, live in smaller families, have had more opportunities for travel, have richer play experiences, and are surrounded by a reading environment far richer than the children having a meager background. The study seems to justify the conclusion that the technic used in determining richness of background, or a part of it, could be used in mapping out instruction procedure, in grouping children, in enriching the curriculum, and in understanding some of the underlying causes of failure in learning to read.

Surveys—This use of tests is the one with which the state and national testing programs are largely concerned. A survey is conducted primarily for the purpose of comparing schools with schools, cities with cities, states with states, etc. In other words, such a program is concerned with group results only. Douglass (216) discussed the effect of state and national testing on secondary schools. The chief objections relate to the artificial determination of objectives and methods, the fact that all instructional activities are directed toward cramming things measured by examinations, and the overemphasis on traditional subjectmatter. Advantages which Douglass suggested have to do with facilitation of comparison, better basis for school marks, motivation for teachers as well as pupils, training for pupils in test taking, and the stimulation of teachers' interest in objective tests. Lincoln and Workman (232) stressed the fact that results of survey tests are not individual performances but group averages. They did, however, classify the use of tests to single out individuals of the group for further intensive study under the survey heading. Horn (227) emphasized the use of caution in the interpretation of survey tests in the evaluation of instruction by reminding (a) that any test measures only a minor part of the total results of instruction, and (b) that relative performance is dependent on a large number of factors of which the result of immediate instruction is but one. Other references to the survey test were made by Segel (253, 255), Johnston (229), and Allen (205).

Diagnosis and remedial treatment—The use of tests for diagnostic purposes is of decidedly growing importance. Supplementary to this usage is remedial instruction and general improvement of instruction. A diagnostic test in any subject reveals which skills have been sufficiently mastered and which require further instruction. Ramsay (247) reported the results of an investigation dealing with diagnostic testing and remedial teaching in the junior-senior high school. His conclusions were three: (a) teachers need not hesitate to undertake diagnostic testing and remedial instruction even with the limited facilities of the small junior-senior high school; (b) large gains are possible by deficient pupils in the ability to study, in the mastery of fundamentals of reading, and in the acquiring of the fundamental concepts of arithmetic; and (c) remedial instruction, as evaluated by teacher judgment, carries over to the instruction of the regular classroom.

The need for diagnostic testing was discussed by Olander (245) who pointed out the poor ability of teachers to diagnose pupils' errors. He reported an experiment in which arithmetic tests were given to pupils individually. They were required to make their calculations aloud, and these were recorded verbatim. Two papers, representing four skills each, were mimeographed and corrected by forty teachers who had no knowledge of the verbatim record of calculations. Later, these records were made available and the teachers were asked to correct the papers in the light of their knowledge of the pupils' methods of work. It was found that the average percent score was lowered by 6.6. The teachers were asked to diagnose the errors before they knew the pupils' methods of work. Results showed that errors in long division were diagnosed with a high degree of accuracy, but the average in the diagnosis of the three other fundamental skills—addition, subtraction, and multiplication—was less than one error out of three correctly diagnosed.

Carter (212) reported a study illustrating the diagnostic testing and remedial procedure involved in a case of reading disability. Such topics are discussed as (a) innate ability and factors affecting performance, (b) school status, (c) initial status in reading, (d) diagnosis and suggestions for remedial work, (e) remedial treatment, and (f) results of remedial instruction.

Smeltzer (257) discussed an efficient method of giving and scoring objective tests for diagnosis in the classroom. Seventy-five test items placed on three mimeographed sheets were distributed to pupils. The numbers from one to seventy-five were written on the board by the teacher. When three-fourths of the pupils had finished, the papers for each row, without names, were collected, and redistributed in another row. Incorrect and omitted answers were checked. Then by counting raised hands, the number of students who made mistakes on each question was recorded on the board. Scores were entered on test papers, the papers returned to the owners, and the names written on them.

A study reported by Whitmer (266) evaluated the progress made by college probationers in the years succeeding remedial work. He concluded that there is a probability that, with assistance, the probation student reaches his level of academic performance more quickly than he would without such help.

Practically any good book dealing with tests and diagnosis is replete with case studies and discussions of diagnostic technic.

Instruction, grouping, and marking—Besides motivating individual remedial instruction, testing is used rather widely in homogeneous or ability grouping. Tests of intelligence are used mainly for this purpose. There has been much discussion of the value of this use of tests with none too clear and definite conclusion as to whether or not its advantages outweigh its disadvantages. A study was reported by Sauvain (250) showing the relative attitudes of parents, teachers, and school officials toward this method. He made the observation that the trend seems to be away from grouping. His study revealed that teachers and principals favor grouping more than do parents, and only those parents whose children are in the lower groups regard the system with real disfavor. From the standpoint of the teacher, grouping is a great aid in instruction.

The Tulsa experiment (263) provides that two types of test be given to children at the completion of the second grade, type 1 to divide the rapid from the less rapid learners, and type 2 to test reading, arithmetic, writing, and spelling. The rapid learners are then divided for each subject on the basis of achievement. Achievement testing and regrouping take place at the end of each semester. The child does not know whether he is in a higher or a lower group; he is promoted regardless of his classification. Ten or more levels in each of the tool subjects are provided and reclassification is easy. The age of entrance to junior high school is the same, under this plan, as under an ordinary graded system.

O'Shea (246) suggested an improved method of administration in the elementary school wherein intelligence group tests are used to determine (a) the mean mental age of the class, (b) who the superior and inferior pupils are *likely* to be, and (c) what the original tentative group should be with which later-formed subject groups may be compared for gaining valuable information concerning individual abilities, interests, and effort. Classifications should include a definite range of intelligence quotient and chronological age.

Woody and others (270) made a study of the effects of measurement on instruction. They concluded that "measurement properly conceived is an integral part of the complete teaching process and as such becomes an important agency in directing the choice of subject matter and methods of teaching."

An aid to instruction is found in the workbook and instructional tests. Van Liew (265) discussed the justification of the workbook and enumerated standards upon which a justification depends. He stated that the workbook can be justified only when the pupil is given something to do beyond merely reading and remembering subjectmatter—only when he is given something to make him understand, appreciate, think, apply, or construct. Some standards upon which the justification of the workbook hinges are: let it (a) guide and aid study, (b) present facts with a view to significant organization, (c) avoid mere syllabus forms and topical outlines, (d) distinguish between working exercises and practice exercises, (e) be constructed with due respect to teaching procedures, (f) parallel a particular text, (g) aid teachers in use of good textbook, and (h) introduce pupils to serviceable ideas of methods and sources making for independent study.

Maxwell (238) presented arguments for and against the use of the workbook as an instructional aid. Arguments for it include the following: (a) the workbook develops initiative and independence on part of students; (b) it presents material in definite sequence; (c) if outlined to accompany a particular text it assures the securing of that point of view and the covering of essential materials as intended by the author; and (d) it reduces the labor of the teacher. Opposing arguments include: (a) the workbook tends to stultify originality because the references are limited to one text; (b) it tends to minimize individual differences; (c) it emphasizes the teaching of the textbook rather than the development of the child; (d) it tends to stress memory work; and (e) teachers follow workbooks too slavishly.

The results of achievement tests are used for marking pupils. This plan yields comparable results from group to group, since standardized tests provide the norms. Macomber (237) said, "as a measure of academic ability, records of standardized achievement tests over a period of years, together with records showing the actual attainment of educational goals in terms of mastery of units of work, are most meaningful." The advantages and disadvantages of marks, together with the existing needs which can be taken care of by results of standardized tests were reported by Ayer (207). The case against marks shows that marks given by teachers are inaccurate and often based upon items other than the actual trait being measured; overemphasis is placed upon high marks and the disgrace of low marks has been detrimental to pupils; marks put too high a premium on the acquisition of subjectmatter and too little upon the improvement of the child. The case for marks shows that the best progress is made when learners are aware of the rate of their improvement; quantitative marks are essential for classification, educational guidance, and research. The elimination of marks does not do away with failure but merely covers up poor work. Marks should be made more reliable, more specific, and more discriminating and should be used as checks or guides rather than rewards or punishments. The use of standardized tests may well make marks more reliable, specific, and discriminating.

Experimentation and research—Objective tests, because of their superiority to other measuring devices, are a great aid to educational experimentation. With the aid of measurements, the experimenter is able to set up groups which are equivalent in such traits as he wishes to control. The controlled experiment is most widely used in studies where the effect of a single variable is to be measured. Such problems as the value of different methods of instruction or of different textbooks, the effect on achievement of size of class, etc., are typical of the use to which this method may be put. Lincoln and Workman (232) discussed the method, listing several essential points, such as (a) wise choice of subjects, (b) careful selection of place and time of experiment, (d) control of desired experimental factors, and (e) accurate measurement of experimental factors. Several illustrative cases of experimental method were presented.

Robb (248), for example, reported a controlled experiment to determine the results of direct and incidental methods of instruction in the field of character education. The control group was composed of 182 junior high-school pupils and the experimental group of 110 twelfth-graders. Moral knowledge and ethical discrimination were measured, showing relatively small difference in the two groups. The incidental method, i.e., "purposeful instruction in the development of character through the creation of related experiences closely integrated with the traditional divisions of subject matter, and with pupil awareness of such instruction reduced to a minimum," was used with the control group, whereas the direct method, "involving a clearly planned course of study in moral instruction," was employed with the experimental group. All comparisons by means of rating scales were in favor of the experimental group, even though the difference was small in some cases. "The superiority of the instructed group was greatest on the ethical discrimination test, and least on the ratings given to one another by the students themselves."

Longstreet (233) employed the controlled experiment method in an experiment with the Thurstone Attitude Scales in which he attempted to determine to what degree high-school pupils' attitudes toward patriotism, the United States Constitution, and war are affected by courses in American history and civics. He found that high-school pupils' attitudes are not changed unless the instructor makes special effort to effect such changes. Segel (256) suggested the use of the controlled experiment to evaluate instruction by radio. Such a study, reported by Gordon (224), was carried on at the University of Wisconsin to evaluate the effectiveness of the radio in the subjects of current events and music. Twenty-five rural schools composed the experimental group and an equal number, chosen by the county superintendent, made up the control group. All schools were provided with the same study materials. The control group was taught by the classroom teacher, but in the case of the experimental group, all instruction was given by radio. Results of the experiment showed that the "materials contained in the radio lessons were better taught than without the aid of the radio."

In the one-group method of investigation, on the other hand, a single group is considered. For example, Charles (214) compared the intelligence quotients as shown by three different mental tests applied to a group of incarcerated delinquent boys. He found that about the same difference exists between the result obtained by the Otis and the Kuhlmann-Anderson as exists between that obtained by the Otis and Binet-Simon. There is a much closer agreement between the Binet-Simon and Kuhlmann-Anderson than between either of them and the Otis, which is estimated as yielding results about ten points too high. Similarly, a study was made by Engle (217) of the personality of a group of high-school honor pupils showing that there is no single factor which correlates significantly with scholarship in this group. With the aid of this one-group method, Wrightstone (271) made a study of the correlation among tests of high-school subjects prepared by the Cooperative Test Service. He found that among these tests there is a higher correlation than "can be explained by the hypothesis of a general factor of abstract verbal intelligence."

The correlation formula is often used in this one-group method of experimentation. This procedure has been employed, for example, by Baker and Broom (208) in a study of a criterion for the choice of a primary reading test. Data yielded by results of six standardized reading tests administered to about ninety students were correlated. The tests were found to validate each other very well, as the coefficients of validity ranged from .57 to .84. Also, Stagner (258) made a study of the intercorrelation of six objective personality tests. Correlations were found to be mostly low, with cases of high relationship when identical elements were involved. Moore and Steele

(241) attempted to evaluate six most frequently used tests of personality. These tests were administered to fifty-eight students at Mount Holyoke. General results warrant the inference that "the atomistic method of evaluating personality seems to have very little promise. . . . An entirely different method of approach . . . seems necessary." Jenkins (228) investigated the Standard Graduation Examination for Elementary Schools as a means of predicting success of pupils in certain high-school subjects. This was done by means of correlating test scores on the Standard Graduation Examination and high-school grades. Results showed that the total score predicted success in social studies better than for other fields; "in general, there is a direct proportion between persistence in high school and comparative total score on the test." Seagoe (251) made an evaluation of certain intelligence tests by means of this method. In general, it was concluded that primary tests agree less with upper-grade tests than the latter agree with themselves, and the former will correlate less highly with school achievement than the latter.

An excellent evaluation of the validity of certain questions which purport to measure neurotic tendencies was given by Landis and Katz (231). The Bernreuter Personality Inventory was administered to 184 house patients and 40 out-patients of the Psychiatric Institute of Ohio University at Athens, either in small groups or singly. All of the subjects were "voluntary" patients at the Institute and all were fairly cooperative and interested in the test. The authors concluded that "the personality inventory gives results indicative of poorly adjusted personality when the individual receives a high score; when the individual receives a low score, we are not justified in drawing any conclusion concerning the satisfactoriness of his adjustment to life. On direct validation, we found that about three-fourths of the self-descriptive statements given by the neurotic individuals really agree with the externally ascertained facts concerning those individuals."

On the whole, it may be said that the standardized test has opened an avenue in the educational field which before was hardly accessible because of the subjective methods of research which necessarily were used. This facilitation of research has added greatly to the precision and care with which materials are now devised, and may be said to be responsible for a great part of the changed attitude toward tests and testing. Education is gradually becoming a science and its practices are being based upon carefully determined facts.

Guidance—The topic of guidance is so all-inclusive that it seems wise to consider several different aspects of it. Williamson (267) defined educational and vocational guidance as "a process of assisting pupils to select and become informed about that occupational field which is consonant with their demonstrated aptitudes, interests, and experiences, and to secure training in line with this choice up to the limit of their educability."

In every classroom there are those pupils who do not respond to the normal routine. Their difficulties may be caused by obvious factors or by a subtle maladjustment whose symptoms are not outwardly manifested. For this reason, guidance is not to be concentrated on vocational and academic factors alone, but is to include all possible aspects of the individual. Fortunately, the progress of guidance programs has been facilitated by the development of tests of personality, attitudes, character, etc., which, although in need of much greater perfection, give promise of real usefulness in the future. The use of such scales, together with other data collected over a long period of time, according to Segel (255) "will furnish better means of predicting success in school or in different curriculums than we have hitherto had." Heck (225) said, "Many attendance problems would never have been problems if a psychological division had been available where a child could have been adequately studied and where an academic program more in line with his capacities, abilities, and interests could have been provided." McConn (235) felt that the introduction of a guidance program should begin in the secondary level because the high schools serve a much larger group. With this arrangement, the college guidance program might be carried on as a continuation of that started at the secondary level with accumulated data available. Evans (218) reported such a guidance experiment carried on in the Pratt, Kansas, High School over a period of three years. The procedure was as follows: (a) the counselor acquired a mass of knowledge about the pupil's interests from observation, interest tests, and personal interviews; (b) the counselor, pupil, and parents met at the pupil's home to plan a schedule for tenth, eleventh, and twelfth grades and this schedule was filed away on a card. The results of such procedure after three years of operation showed: (a) the vocational counselor had become valuable to the school; (b) the pupil chose electives more wisely; (c) parents became a part of the school system; (d) the pupil had incentive for doing better school work because he had a goal to attain; and (e) the principal was given a source of information which enabled him to calculate the demand for certain subjects and plan his class schedules accordingly. Newell (244) discussed the methods of child guidance adapted to a public school program. His purpose was to give a glimpse of the case study method. He described several representative studies considered by the psychological clinic.

In summary, he says, "Our usual procedure with a new case is to undertake intensive work with school, home, and child for a few weeks. It is then often possible to discontinue active treatment, merely keeping the case under observation." In every instance, the accumulation of essential information as a basis of guidance involved the use of tests and measurements.

Controversy exists concerning the validity and reliability of scales purporting to measure traits of character. Typical of the attitude of the opponents is that expressed by Gillingham (223), "To extend the measurement idea to personality is to attempt to harness the infinite." The opponents feel that character traits are too elusive and intangible to offer a reliable result of measurement and that the tests themselves are invalid.

On the other hand, there are those who are more optimistic concerning the feasibility of measuring traits of character. Although they fully realize the shortcomings and imperfections of such scales, they believe that the future gives promise of their usefulness. Stephens (259) asserted that "the very foundation of all sound guidance programs is built on carefully arranged personal data much of which consists of the results of various kinds of examinations or tests." The Seventh Yearbook of the Department of Classroom Teachers of the National Education Association (242) presented a discussion of personality tests and their uses. Especially noteworthy is the bibliography concerning major problems of elementary-school children and secondary-school children. We read here, "An effort to formulate tests and other devices for the discovery and measurement of factors related to personal development and adjustment has gone far enough to give promise of real usefulness in the future." A bulletin of the Research Division of the National Education Association (243) stated that "although progress is being made, it seems unlikely that the status and needs of the whole personality can ever be discovered with the precision and economy of time now possible in the measurement of general intelligence and subjectmatter learning. . . . The foregoing statement does not imply that available testing procedures have little value in uncovering personality difficulties." There follows a discussion of various studies of personality tests and testing. Segel (254) in speaking of the increasing number of attitude scales constructed under the direction of L. L. Thurstone, says, "These scales appear to be valuable instruments in the evaluation of effects of different environments upon people. These scales will make possible a better approach to the measurement of the effect of motion pictures, radio, and newspapers." Other references to personality tests and their uses were made by Tyler (264), Heck (225), Horn (227), Lincoln and Workman (232), and Woody (270).

The clinical approach to guidance is cognizant of the individual as a composite organism, the study of which must necessarily take into consideration many different aspects. The dangers of interpreting results of a single test as final are pointed out by presentday clinicians, psychologists, and psychiatrists. A good description of clinical procedure was presented by Carter (213) who summarized the work of the psycho-educational clinic at Western State Teachers College, Kalamazoo, Michigan, over a two-year period and presented a reading case which he described as being "partially adjusted" at the end of the remedial period. Factors considered by the clinic in diagnosis were family history, developmental and medical history, school history, and clinical data. Faculty members of the Department of Education and Psychology acted as counselors for certain students assigned to the cases, and, in some instances, cases were handled by faculty members alone. Of the sixty children studied and treated at Western State Teachers College during this two-year period, 25 percent were designated as "satisfactorily adjusted," 52 percent as "partially adjusted," and 23 percent as showing no improvement whatsoever. Henry (226) also presented a description of clinical procedure in a review of a behavior problem considered by this clinic. Robinson (249) discussed the responsibilities of a child guidance clinic in relation to mental hygiene. He views the clinic as a medical institution whose primary responsibility is to the individual child. These clinics should participate fully in the mental hygiene movement, ever recognizing the needs of the community and ever coordinating home and school. Finally, educators will recognize, through clinical experience, that non-promotion is a major mental hygiene hazard, and that it may be necessary to sacrifice grade standards to protect the child's mental health.

Schools for which clinical service is available are indeed fortunate, but the lack of such service does not mean that the clinical approach to a problem cannot be used. For example, we read in the Seventh Yearbook of the Department of Classroom Teachers of the National Education Association (242): "The teacher of today must be more than an instructor. He must be to some extent an experimental psychologist, a diagnostician, and a guidance expert. He must be a practicing physician in the realm of personality, interested both in curative and preventive medicine."

An essential part of the guidance program is a cumulative record system for the purpose of presenting college entrance information, counseling during school years and after school years, prediction of personal success, aid in choice of vocation, etc. The American Council on Education (206) has prepared a form for such a system. This form is discussed by Wood (269) who says, "The American Council Committee on Personnel Methods advocates a method identified by its central and unifying instrumentality—the cumulative record of measures and observations recorded in comparable terms in a form convenient for rapid, accurate, and comprehensive interpretation of growth trends, which is to be used carefully and continuously by all who take the responsibility of advising pupils." Significant features of the record pointed out by Wood are: (a) it is arranged in calendar unit columns which facilitates detection and interpretation of trends in development and also gives cross sections of the individual's recorded status at any time; (b) the measures used are comparable from year to year giving meaningful indications of growth in any function tested; and (c) it provides spaces for objective measures of interests and personality traits, for concrete evidence of interests and development, and for teacher's judgment. A form has also been prepared by the Educational Records Bureau shorter than that of the American Council on Education.

Summary

By way of conclusion, it may be said that the summary of the previous pages bearing upon the present tendencies in the uses of educational measurements indicates clearly that tests and measurements for their own sake are rapidly passing from the educational picture. On the other hand, the use of tests as an integral and essential part of educational procedure and research is growing. Using tests for what they may contribute to the realization of the important aims of education and the solution of educational problems appears decidedly to be the modern tendency.

CHAPTER III

Objective Achievement Test Construction

THE LITERATURE on educational achievement test construction during recent years has exhibited a noticeable change in character. Before 1930, writers on test construction were concerned primarily with the comparative merits of the so-called "old" and "new" types of tests, with the statistical technics employed in the gross evaluation of tests, with the preparation, standardization, and statistical evaluation of specific standardized tests, with the development of new test forms, and with the experimental determination of comparative validities and reliabilities of objective tests of various types or forms. Recently there has been some tendency, not as marked as might be desired, to recognize that the statistical technics ordinarily used in test evaluation are far more fallible and less meaningful than had been supposed; that the factors which account for differences between *types* of tests are far less significant than those which account for variations in quality between tests of the same external form; and that much more can be learned about these latter factors through *internal* analyses of test materials—through qualitative and subjective as well as statistical analysis of individual items—than through gross statistical evaluations or comparisons of complete specific tests. Consequently, there has been some diminution in the relative number of articles dealing with studies of comparative validity and reliability, particularly of the old and new types of tests, and of articles reporting the characteristics of specific standardized tests. A much larger proportion of articles than formerly has been concerned with item analysis technics, and relatively more attention has been given to qualitative and logical, as opposed to statistical, considerations in general.

The Concepts of Validity and Reliability

The early literature on testing was characterized particularly by much loose thinking and by many serious misconceptions concerning the nature of test validity and reliability, by undue confidence in the statistical technics employed to measure these characteristics, by serious exaggeration of the relative significance of the reliability characteristic in test analysis, and by what has been described as the "jingle fallacy"—that of naively assuming without adequate evidence that a test really measures what its name implies that it measures. The literature of the past two or three years has contained several discussions which should contribute significantly to a clarification of current thinking in this area. In the opinion of the reviewers, each of the first three or four of the discussions reviewed in the following paragraphs is deserving of careful study by anyone seriously interested in the problems of test construction and use.

these materials are administered, and that unless this time factor is controlled, studies of the comparative validity and reliability of different test materials are likely to prove inconclusive. They defined "optimum administration time" as the length of time of administration of a test in which the highest validity is secured per unit of time and proposed an experimental procedure for determining this optimum time empirically. They investigated the relationship between administration time and validity and reliability for six forms of a spelling test, and showed that the nature of this relationship varied from one type of test to another.

Tinker (342) wondered if the "speed attitude," the feeling of working against time, might lower the validity of tests. He gave two forms of the Army Alpha test to 221 freshmen and sophomores with different time allowances and found that the scores were almost as high and the tests equally valid when the students worked against a time limit large enough to allow all of them to attempt most of the items as when there was no time limit at all. He concluded that it is all right for students to have the speed attitude when taking tests, i. e., to be working under pressure, provided a reasonable time is allowed for the test. Caldwell (282) found very similar results with seventh-grade children on the Stanford Achievement Reading Tests. He analyzed the results on various intelligence levels and found that the students of lower intelligence required more time than the more intelligent pupils to reach their maximum scores.

2. *Practice on tests*—Anastasi (272) conducted an experiment with college students which showed that test reliability increases with practice on the test when the test is administered by the time-limit method and reliability is measured by the odd-even technic. She discussed four factors which sometimes cause variations from the above generalization. Her report includes an exhaustive summation of the experimental evidence on the problem.

3. *Instruction between test administrations*—Copeland (287) explained the data found by three other experimenters, in which tests were less reliable when given at the end of a teaching period than when given at the beginning of the period, on the basis of decreased range of talent at the end of the period due to the instruction received.

4. *Directions on true-false tests*—Weidemann and Newens (351) performed an experiment to find the effect of provision of different sets of test directions for true-false and indeterminate statement tests upon the time required for the administration of the test, upon the reliability of the test, and upon the central tendencies and variabilities of the distributions of test scores. Few significant differences in performance were found between tests with various sets of directions. The final conclusion of the experimenters was that one should "use a set of directions for true-false and indeterminate statement examinations whose definitions for response on the decision scale correspond to the nature of the instruction for each item of the course."

5. *Arrangement of items according to difficulty*—Using 453 pupils in the Minneapolis fifth and eighth grades, Capron (283) found no significant differences in performance due to the arrangement of items in objective tests in spelling, arithmetic problems, and the fundamental arithmetical processes. Easy-to-hard, hard-to-easy, and random arrangements were used.

Measurement of Validity and Reliability

A comparison of the advantages and limitations (due to assumptions involved in their use) of the tetrad technic, the split-halves technic using the Spearman-Brown prophecy formula, and simple correlation of two forms of a test as measures of reliability was made by Dunlap (294). He concluded, among other things, that "the Spearman-Brown formula will give a very close approximation to the reliability of the total form, as split halves will in general be approximately equally reliable." Brownell (279) would be skeptical about this statement, especially if applied to comparatively short, non-standardized tests. He obtained variations from about .30 to .55 in the reliability coefficients of single tests measured by the split-halves method and the Spearman-Brown prophecy formula when the test items were arranged in different orders. Such evidence is taken to indicate the necessity of considering carefully the assumptions underlying this technic when using it to measure reliability. Brownell pointed out that most texts on statistics say very little about the conditions under which the formula may properly be used, and consequently much misuse results.

Handy and Lentz (299) developed a formula to express the reliability of a test in terms of the discriminating value of the individual items, these values, in turn, being computed by comparisons of the responses to each item by the subjects who ranked in the upper 30 percent and in the lower 30 percent on the entire test. Dickey (293) worked out a formula for estimating the reliability coefficient of a test for one range when its reliability coefficient is known for a given range. Because the standard error of estimate of his formula is smaller than that of the similar formula developed by Kelley for the same purpose, Dickey claimed it is the better of the two. Cureton (291) discussed a method and appropriate formulas for finding the reliability of a fallible criterion, such as college success or a series of judgments, against which the validity of a battery of tests is to be computed.

Consistency of Responses

Dewey (292) gave a reading comprehension test composed of several different types of objective items, with several items (of different types) testing each idea, to fifty-five eighth-grade students. The consistency with which answers were made, either right or wrong, ranged from less than 50 percent among the least intelligent students to less than 67 percent among the most intelligent. The conclusion was that a response to a single item or even a single type of item is a questionable measure of a pupil's understanding of an idea. Similar findings were obtained by Brueckner and Elwell (281) in tests on the multiplication of fractions. They recommended including three or four examples of each kind in a diagnostic classroom test in arithmetic because of the many errors due to factors other than the understanding of the correct procedure required to solve the problem. Brueckner and Hawkinson (280) followed up this study by experimenting to see whether or not placing all four examples of one type together in a row (which procedure would make scoring and analysis much easier than if the related items were scattered throughout the test) would affect the number or kind of errors made. It did not, and so such grouping of similar items is advocated.

Comparative Validity and Reliability of Specific Test Forms

The literature on testing during recent years has contained a decreasing proportion of studies concerned with experimental determination of comparative validities and reliabilities of various types of objective tests. Most of the studies of this character which have appeared, including a number of those which are reported below, are subject to certain general criticisms which may in part account for the decreasing activity in this field of research. These general criticisms are as follows:

First, the studies of comparative validities and reliabilities thus far reported have in most cases attempted to determine the relative effectiveness of the various technics in *general* rather than in relation to specific fields of subjectmatter or in relation to any specific objectives of any given field. Whatever advantages or superiorities any type of test may have, however, are specific advantages in specific situations. Generalized conclusions not only are of little or no positive value but may even be definitely misleading, since they may result in a general condemnation of types of tests which in specific instances or for restricted purposes might be highly valuable. In order to be of value to the test constructor, comparative studies must determine the relative effectiveness of various technics for highly specific purposes. Few studies of this type have yet been made. Because of their highly generalized nature, the majority of studies thus far reported contain little or nothing of value to the test technician in the solution of specific problems.

Second, the majority of reported studies of the relative effectiveness of various testing technics have based their conclusions concerning the "relative effectiveness" of the technics investigated primarily upon determinations of their comparative *reliability* or self-consistency. Objective and dependable descriptions or measures of *validity* are often extremely difficult to secure because of the lack of any acceptable independent criterion of validity. Reliability coefficients, on the other hand, can usually be easily determined. For this reason, there has been a tendency to give undue prominence to the concept of reliability. The reliability or self-consistency of any test or testing technic, however, is of very minor significance in comparison to the validity of that technic in relation to the specific purpose for which it is intended. Considering the fact that the reliabilities of a number of tests intended for the same purpose may, in some instances, even be negatively related to their validities, experimental comparisons concerned primarily or exclusively with the reliability characteristic are likely to contain little of value to the test builder.

Finally, the majority of comparisons between various technics in testing that have been reported have failed to control certain important factors which of themselves could readily account for the differences which have been found. Among the most important of these factors is the skill or ingenuity of the test builder. Investigator A, for example, who is interested in measuring the amount of scientific information acquired by high-school pupils in general science, builds a true-false test and a matching test over the same items of information. In this situation he might show that *his* true-false test is more reliable and valid than *his* matching exercises. This may only prove, however, that A is more ingenious in the construction of true-false tests for this specific purpose than he is in the construction of matching exercises, and may show nothing at all concerning the relative effectiveness with which these technics may be employed by other test constructors in the same or in another situation. The validity of any test in relation to a given purpose is far more a function of the skill or ingenuity evidenced in the application of the technic used than it is of the type of exercise employed. Where this factor of skill or ingenuity in test construction is left uncontrolled, comparisons of obtained measures of validity or reliability of two types of tests may only show the degree to which the test builder has realized or approached the ultimate possibilities of each type of test in the situation involved, and may not indicate at all how they would have compared had their respective possibilities been *fully realized* in that situation. There are few studies in which this factor has been even recognized and practically none in which it has been adequately controlled. Considering, furthermore, the extreme difficulty of controlling this factor in the experimental situation, it seems unlikely that empirical studies will contribute very much to the better evaluation of the various types of objective test exercises. An exception to this generalization may be noted in the case of those few fields where it is possible to provide a detailed and objective description of the manner in which the individual items are constructed, i.e., those fields in which the ingenuity of the test constructor plays a relatively minor role or can be held constant, as in tests of spelling, of the basic arithmetical skills, and of the mechanics of correct writing. Another factor frequently left uncontrolled in experimental comparisons of the type here considered is the factor of administration time, which has been discussed briefly in an earlier reference. The foregoing considerations should be kept in mind by any reader who has occasion to refer to the articles briefly summarized in the following paragraphs.

Cook (286), in a carefully controlled experiment, determined the relative validities of six forms of a spelling test when each was administered at its optimum time. In general, the recall types were found to be superior to recognition tests and the latter to be improved in validity by corrections for guessing.

A five-response multiple-choice test of word meanings, a "same-opposite-neither" test, a matching test, and a multiple-choice test in which the stimulus word was given in a sentence were compared in validity by V. H. Kelley (310) by correlating them with a criterion test in which the subjects were asked to use the words in a sentence. The optimum testing time for each test was determined by experimental procedures and each test given in the time which gave it maximum validity per unit of time. The tests were compared in difficulty and in validity as measured by the percent of agreement between each and the criterion test on individual items. The same-opposite-neither test and the multiple-choice sentence test were lower in validity, though there was not a significant difference between them and the others. The matching and multiple-choice tests were most valid, and the latter most difficult.

Sims (332) experimented with 5-, 10-, and 15-item rearrangement tests on the college level, each item consisting of 5, 10, or 15 headings taken from a psychology text which were to be arranged in logical sequence, and found that they compared favorably in reliability and correlated highly with other measures of achievement in psychology and of intelligence. The 15-item type took longer to write and considerably longer to score but was more reliable than the other two; it was recommended in cases where only a limited number of items was available. Weller and Broom (352) studied the validity of six types of spelling tests. They found that the proof-reading type of test measured something different from what is measured by the recall type of test. The sentence-dictation test was considered most valid. Correlations between types were low; within types, high.

Because he found that individuals were often inconsistent in their answers to items similar in content but different in form, Magill (320) maintained that the burden of proof rests upon those who hold that true-false, multiple-choice, and recall tests are of approximately equal validity and therefore use them indiscriminately. He gave tests of these three types covering the same information to two groups of teachers in service; intercorrelations of resulting scores were high, but individual responses were very inconsistent. Corrections for guessing did not change his results materially. Hurd (308) compared a short-answer with a multiple-choice type of science test in validity, reliability, and difficulty. The tests covered identical subject content. The reliability coefficients computed by the split-halves method were .93 for the short-answer test and .82 for the multiple-choice test. The correlation between them was .78. The latter test was the easier of the two. The short-answer type was said to be more valid because larger gains were made on it between the first administration of the test (before instruction) and the second administration (after instruction) than were made on the multiple-choice test. (This seems to be a doubtful criterion of validity, especially in view of the difference between the tests in difficulty of items.)

Innovations in test form—The true-false test has been most often "improved." Briggs and Armacost (276) found that oral true-false tests for immediate recall compared very favorably with such tests presented in visual form. The reliability of a 50-item test which they gave to a college class in junior high-school procedures was about .69; stepped up to 100 items, it would be .81. Its obvious advantage is the saving of time and expense involved in mimeographing copies of the test.

An attempt has been made to improve the true-false test by requiring the student not only to recognize a false statement when he sees it but also to know enough about why it is false to be able to correct it. Horn (304) described what she called the "variable answer" test in which the students were to correct the false items; scoring was somewhat subjective. Andruss (273) required his students to correct the false items by crossing out just one word and putting another in its place. Then he built his test so that there could be only one correct one-word correction. It made test-building rather difficult but secured objective scoring and combined the advantages of the true-false, multiple-choice, and completion tests. The test was scored by awarding one point for correctly indicating that an item was false, one for crossing out the right word, and one for putting the correct word in its place. Hevner (301) increased the reliability of a true-false test by allowing the pupil to indicate his confidence in the correctness of his answer and weighting each response according to the degree of confidence shown in it.

The multiple-choice form of test has also been shown to be usable when presented orally. Sims and Knox (333) checked 3-, 4-, and 5-response orally presented tests against a 5-response visually presented test as a criterion, and found them to be a little more difficult and a little less reliable than the visual test but not so much so as to invalidate their use. The 5-response oral test was superior to the other two. Scheidemann (331) suggested asking the pupils to indicate *all* correct responses to a multiple-choice item rather than the *one* correct response. Frutchey (297) explained a practical modification of the multiple-choice type of test for the measurement of ability to apply chemical principles.

Some investigators have reported experiments with test forms widely different from the commoner types. Desiring to measure application of information, Smeltzer (334) compiled tests in which each item consisted of a description of a practical situation and several suggestions as to what should be done by the student in such a situation. Students rated the answers on a scale of one to five. The keys were based on the judgment of several professors, and errors on the part of those taking the test were measured in terms of their numerical deviations from the key on each response. Brooks (277) described a test used in his history of education and introduction to education classes in which he lists 100 terms and asks the pupils to underline all the terms they can define and then to go back and actually define every fifth one. The percent of correct definitions multiplied by the number underlined gives the score. The procedure saves time; of course, the scoring is subjective to the extent that the terms listed may be variously defined.

Miscellaneous considerations—Lamson (313) raised the question of what happens when a student changes his answer on a true-false test. Her conclusion, based upon 144,000 items from 1,511 papers of college students, was that "it is better to record a second judgment in a true-false examination than not to record it. The chances are two to one that the second judgment will be the correct judgment. It is much safer to change a judgment from true to false than vice versa."

Stalnaker and Stalnaker (337) found that selected distractors (words commonly confused with the word in question) in a 5-choice best-answer vocabulary test were marked more often than chance distractors (those selected at random). There was no interference with discrimination, so their use is recommended.

Item Validity and Reliability

Methods of determining item validity—The importance of measuring the validity, or effectiveness, of a single test item as an aid in the construction of more valid tests has been recognized by investigators, and a variety of methods for computing an index which will give an objective description of the worth of an item have been suggested and used. One of the principal limitations of most of these indexes is that they are concerned only with the correlations between a single criterion and the responses to individual items, and do not take into consideration the intercorrelations between the item responses. Theoretically, the best test is that in which the individual items correlate highly with the criterion but show relatively low intercorrelations. An item with a high index may, therefore, prove less valuable when used together with other highly related items than another item which has only a medium index but which shows low correlations with other items in the test. Another practical limitation of the indexes prepared is that their worth depends upon the validity of the criterion employed, and that reliable independent criteria are not often available. When the criterion employed is the total score on the test itself, the index for an individual item is strictly a measure of the extent to which the item contributes to the reliability rather than to the validity of the whole test. For these reasons, extreme caution must be exercised in the interpretation of results with most of the procedures suggested in the articles reviewed in the following paragraphs.

Lindquist and Cook (316) set up five criteria for an index of discrimination and compared five different indexes with reference to those criteria.

They found the bi-serial r index of discrimination to be the best indication of the value of an item in contributing toward the ranking of students according to general achievement. The calculation of this index requires a great deal of computation, however, and is therefore rather impractical in situations where machines are not available for the purpose. A simpler index which may be calculated without the use of machines and which gives quite satisfactory results was suggested as an alternate procedure.

Richardson and Stalnaker (329) suggested and gave the derivation of a formula for the computation of a bi-serial coefficient of correlation which they claimed was based on more suitable assumptions than the one usually used in analyzing test items. Zubin (357) reviewed three methods of internal validation of test items: the critical ratio, bi-serial r, and association methods. Formulas were worked out to correct for errors due to the customary practice of including the item under analysis in the total score when calculating these indexes. Zubin rated the three methods roughly on the basis of ease of application, limitations, and underlying assumptions.

Long (317) devised an improved overlapping method of measuring item validity which correlated very highly (r of .94) with the bi-serial index on a 110-item general science test. The method depends upon no statistical assumptions, is easy to understand and to compute, is not affected by the difficulty of the item, and has been found to be slightly superior to the bi-serial r index of discrimination in selecting items which correlated highly with the criterion used. Long also developed a further "weighted overlapping formula" which has even higher selective value; it is weighted according to the number of "differentiations" an item makes.

Statistical theory and formulas for the evaluation of test items by the method of successive residuals, which takes into consideration discrimination plus intercorrelation of items so as to avoid having the items all test exactly the same thing, were developed by Horst (307). He also illustrated a work sheet for use in carrying out the mechanical operations involved in evaluating items by this method.

Votaw (349) worked out a method of correcting for guessing when measuring the validity of test items so that comparisons between performances of good and poor students would be measured by the proportions of the two groups who really *knew the answer* rather than by the proportions who *answered it correctly*. The result of the use of this plan in evaluating items was the retention of more items which were selective at the low end of the distribution so that better discrimination among the poorer students was obtained. A scheme was devised for detecting items which had "tricked" good students into making incorrect responses.

Votaw (348) explained a technic for working out a graph with which to determine the selectivity of test items. Arnold (274) presented a variation of this in chart form.

Application of data on item validity—The determination of an index is merely a means to an end. The question of how to make use of it in test construction is an important one upon which there is little experimental evidence. Smith (335) gave a 200-item vocabulary test to 370 bright eighth-grade children, computed the bi-serial r indexes of discrimination of the items, and ranked the items according to these indexes. Then he made four subtests of 20 items each (using the 20 highest ranking items in one subtest, the 20 lowest ranking in another, and two intermediate sets of 20 items, one above the average and one below, for the other two subtests) and used the remaining 120 items as a criterion test. All 200 items were given to two more groups of 500 pupils each. The entire test was more valid when the subtest of lowest ranking items was omitted, but the omission of any of the other subtests lowered the validity of the test as a whole; therefore, Smith concluded that in improving a test the "worst" items should be discarded but all items with indexes above .40 should be retained even though there are many items with much higher indexes. In other words, although these items are of medium low validity as measured by the index used, they measure something which needs to be measured and which the items with higher indexes evidently fail to measure, and so they should not be discarded.

Lindquist and Anderson (315) discussed the factors which affect the discriminating power of items and gave specific illustrations of items which proved ineffective in actual practice, pointing out the reasons for their failure to discriminate well.

Relation between item difficulty and validity—Henry (300) found no significant relation between the difficulty of an item and its validity as measured by the bi-serial r method, the Clark method, the Vincent method, the upper and lower thirds method, and a combination of them all. Horst (305) developed a formula to express the difficulty of a multiple-choice test item as a deviation from the mean of the group in standard deviation units. He deduced the idea that multiple-choice items with fewer alternative responses which are equal in difficulty are more valid than those with a larger number of choices presenting a wide range of difficulty.

Reliability of test items—Holzinger (302) worked out formulas giving the standard error of response or measurement of a single test item. He stated:

> The response error of series of items is already known. The problem, then, is to find this error for a single item and show the relation to the standard error of a series of such items. It is hoped that these new formulae will be of some value in building up tests of items of known reliability and in predicting the final reliability of a number of such items when combined. Conversely, it is believed the formulae may be useful in appraising the reliability of tests of different lengths by reducing the measure of reliability to the average item basis.

Collection of data for test validation—Horst (306) described a procedure for building a test of personality and mental alertness in such a way as to try out a large number of items with a minimum of test administration. He divided his try-out group into two groups, gave each a set of items of two types, and then predicted what the score of each individual would have been had he taken a test on all the items of one type. In this way twice as many items may be tested as is usually done. The method and formulas may be applied to any type of test.

Scoring

1. *Errors in scoring*—Rauth (328) compiled data showing that errors are frequently made in scoring objective tests, and listed the most common types of errors made in scoring various test forms.

2. *Methods of scoring common forms of objective tests*—The use of mechanical devices and scoring forms in an effort to save time and money and to be completely objective represents the trend in scoring procedure. Bawden (275), Cuff (290), Fay and Middleton (296), and Pressey (326) have reported the use of scoring forms, separate sheets of paper ruled in various ways, upon which the pupils indicate their answers. This plan permits the same test papers to be used again and again. Such score forms may be used with any of the more common types of objective tests; ingenious suggestions for scoring them are many. Cuff (290) ran the answer sheets through a mimeograph so arranged as to encircle the correct responses and make speedy tabulation of the results possible. Fay and Middleton (296) and Pressey (326) recommended a cardboard stencil key. Pressey also described a machine procedure which secured speedy and accurate results—a part of what he called "the coming 'Industrial Revolution' in education."

Cuff (289) told of a mechanical device for scoring multiple-choice test items by *weight*, which is from 10 to 40 times faster than scoring by hand and very much more accurate—practically perfect. Other forms of objective tests undoubtedly could be scored similarly.

3. *Methods of scoring less common forms of tests*—Elderton (295) presented objective methods for the scoring of maps drawn by students and for the combining of time intervals and errors into a single score on tests of mental imagery.

Brown, Bartelme, and Cox (278) explained and advocated the use of a procedure for scoring tests in which items have been so scaled that the scale *values* of the items missed and passed can be taken into consideration. The score of the individual is taken as that point on the scale where the average deviation of the correctly marked items above it equals the average deviation of the incorrectly marked items below it. Examples are given to indicate the superiority of this method over the one commonly used by Thurstone and others, which involves the scale positions rather than the scale values of the items.

T. L. Kelley (309) developed a formula to determine the weight to assign to a given response in a test designed to compare a person's interests with those of some homogeneous group or class of people.

CHAPTER IV

Recent Developments in the Written Essay Examination

From 1923 to 1935, research studies on the essay test may be grouped as follows:

1. The reliability and validity of essay marking, including comparisons with objective tests
2. The measurement of the same or different mental functions tested by essay and objective tests
3. Student preparation for and reaction to essay and objective testing programs.

Reliability and Validity

Wood (389) pointed out that the new type (in this case the true-false) is more reliable when compared with the old type essay examination, and further stated that the essay type "is most apt to measure: cogency of expression, organizing acumen, and reasoning ability." In a second report, he emphasized that "the essay examination is best adapted to the measurement of critical capacity and reasoning ability. . . . The best essay examination is the one which allows the student to choose two questions out of five. . . . The essay law examination is indispensable . . . and . . . it can be improved."

Sims (381), using "the distinctly good questions" collected by Monroe and reported by Odell, found that 34.5 percent were simple recall, 35 percent were short answer, and that only 30.5 percent were discussion questions. Sims stated that the first two are definitely objective in nature and should be built according to established principles of objective test construction, while the third type is more subjective. He suggested that a more satisfactory method of marking the subjective type should be developed. In another paper he (384) indicated how to reduce by one-half the range and probable error of the marks given by different graders. He considered the scores given on essay examinations as raw scores and converted them into the particular grading system of the school by setting the passing point at 1.5 standard deviation of the raw score. Using this procedure, he (383) compared two forms of an essay test of ten questions each with two forms of an objective test each consisting of 34 completion and 40 true-false questions which were given to 80 students in general psychology. The average coefficient of objectivity of rating the essays was .77, their reliability was .72, and the correlation between the essay and objective tests was .70.

Weaver and Traxler (387) based their study upon 5 objective and 5 essay tests made upon 2 units of history and given to 38 pupils. They found correlations from .30 to .60 between the tests and a combined 4-essay test as a criterion and again with a combined 4-objective test as a criterion. Separate test pair reliabilities were not computed. The essay type question used by Weaver and Traxler would be classified by Sims as calling for an objective short answer.

The viewpoint of Sims must also be borne in mind when considering Leighton's suggestion (371) for reducing the sampling error of the essay test by the addition of a large number of short answer questions. He found that when factors to be measured are carefully determined before constructing the essay examination, when the questions are planned and clearly stated, and when criteria for judgments are set up, there is great increase in the agreement of scorers' grades. With these criteria, two graders using the subjective method of grading papers as a unit were able to correlate .63 when grading very subjective material like that of philosophy. They used a 1, 2, 3, 4, 5, fail, ranking of papers. Graders of biology, when using the more objective method of grading each question separately, correlated between .63 and .90 in their judgment of the papers.

Tharp (386) compared old and new type foreign language grammar tests with a third semester test consisting of both essay and objective questions. He found a correlation of .90 for the objective and .83 for the essay test when compared with the grades given in the course as determined by the final examination. He suggested that the objective test will measure more accurately than the essay test alone.

Eells (366) had 61 teachers grade the same essay test material at the beginning and at the end of an eleven-week interval. He found the variability of judgment between the same individual to be as great as the variability between different individuals. Correlations ranged from .25 to .51. The material used consisted of the geography questions from Ruch's experiment and the history material from a previous experiment of Paulu.

Over a period of two semesters, Peters and Martz (379) made an elaborate study of short true-false, multiple-choice, completion, and essay tests in elementary and secondary subjects and correlated them with the final grade given in grades 2 to 12 inclusive, involving 252 students. They concluded from the 196 correlations computed that completion and essay tests do not vary greatly in validity where the criterion of final grade is used. The true-false test was slightly less valid than the completion and essay tests, especially in the elementary grades. The multiple-choice and essay-discussion tests were equally valid in the elementary school, but in high school the essay was more valid than the multiple-choice test. The criterion of final grade with which each of the ten-minute experimental tests was compared was determined one-third by teacher-made objective tests and the ones mentioned above. The latter actually contributed about one-twelfth of the criterion.

McKee (372) equated two groups of 50 students for intelligence in elementary and advanced freshman English and compared their semester grades, determined for the most part by a subjective estimate of written work, with a prognosis made first by an objective test and with a second prognosis made by the use of a theme. Both the test and theme were written at the beginning of the semester. He found the objective test to be a far more reliable prognosticator of superior students in freshman English than the written theme.

Odell (376), in an extensive study involving 23,500 pupil answers to thought questions scored by 57 raters, concluded that the reliability of ratings given with scales was not significantly higher than that given without scales. He further found that with raters having no teaching experience the scales tended to assist in fixing the general test standards but they did not increase the reliability of the actual rating of single answers. This finding is similar to that of Ruch and Stoddard (380) but opposite to that of Hudelson (368).

Monroe and Souders (375) compared two sets of examination papers prepared by pairs of teachers working together and again working individually both in the construction and the grading of final examinations. This work, carried on by 1,736 high-school teachers, showed that while in the best standardized tests both constant and variable errors are distinctly less than corresponding errors in examination grades, nevertheless written examinations may be so improved that differences in accuracy of examination grades and scores may not only be lessened but may yield about the reliability of .65 as found in many widely used standardized tests. They further believe that their results contradict those of Elliott and Starch because the latter failed to differentiate between variable errors (those errors due to different educational aims, different standards of excellence, etc.) and constant errors (those due to no distinction between scores and grades).

Cochran and Weidemann (361), by setting up standard procedures for grading "explain" and "discuss" essay test questions, found consistency coefficients ranging from .78 to .98 between experienced scorers in history. Thirty-five teachers with experience in several high-school subjects and with only ten-minute training in the standard procedures of scoring were able to produce an average consistency coefficient between their first and second scoring of .78 and an average objectivity coefficient, based on 237 correlations of .56.

Leighton (371) criticized the work of Ruch, Elliott, and Starch in two ways. First, the experiment with a single paper and several judges giving a numerical grade is artificial. He suggested that a more significant experiment would be the ratings of a group of papers using the usual comparative value grading rather than the percent technic. Second, there is no evidence that a definite criterion for judgment was offered for the essay test, though such a criterion is deemed extremely important by these men when building an objective test.

Kinney and Eurich (369) summarized the research on comparison of different types of tests saying that there are few conclusive results. They pointed out a double need: first, for experiments more coordinated and of a wider scope than the usual "controlled experiment;" and second, the need for pooling administrative experiences with regard to test construction and use.

The Measurement of Mental Functions

Corey (362) gave an essay test consisting of 6 questions, and an objective test consisting of 96 multiple-choice questions and 13 matching questions to 102 students in educational psychology. The correlation between the essay and the objective tests when corrected for attenuation was .93, thus indicating that the two tests measured the same function. The results of the Army Alpha test for the above group, when correlated with the essay test and corrected for attenuation, yielded a coefficient of .39; but when the Army Alpha was compared with the objective test and also corrected for attenuation the coefficient was .62. Corey concluded that when the essay and objective tests cover the same subject the latter is more closely related to the Army Alpha than is the essay test. The results suggest the possibility that other factors of this study may require a higher degree of control.

Paterson (378) gave a one-hour essay test and a one-hour objective test to students in his five-hour two-quarter course over a period of two years. He found the correlation between the old and new type tests to be .52. As the correlation between these two tests were as high (.52) as the validity of the lowest (essay) test, he concluded that the two examinations were measuring the same thing. It should be noted that the studies by Corey and Paterson compared unimproved essay tests with tests consisting of two or more forms of improved objective tests.

Sims (382) gave thirty-three students an essay examination of six recall and four discussion questions. Eight readers scored the recall questions with a key and scored the discussion questions by sorting them into normal distribution groups. All papers in each section of the distribution were marked with a predetermined score. The variation among the readers was slight, the objectivity of the examination was .97, and the reliability of the examination was .84. The recall questions and the discussion questions did not seem to measure the same thing as the correlation between them when corrected for attenuation was only .53. When compared with an objective test taken by the same group the recall questions yielded a correlation of 1.01 when corrected for attenuation, while the discussion questions yielded a coefficient of .64 when similarly corrected, thus indicating that the latter type of question measured something quite different from that measured by the objective test.

Cochran and Weidemann (360) conducted an experiment consisting of 4 to 8 improved essay questions making up an "explain" essay test, and a second test consisting of from 50 to 100 simple fact answer questions over the same material covered by the essay test. A set of 4 tests was constructed to cover the work of one semester of American history. The tests were given every 8 weeks over a period of four consecutive semesters. The improved essay test was given first and the simple fact answer test was always given on the following day. The median consistency coefficient for the 4 simple fact answer tests was .87; the median consistency for the 4 "explain" essay tests was .55; while the median community of function value was .59 with a range from .54 to .82. As a result of the use of supplementary statistical technics it appeared that the overlapping of mental functions measured by the "explain" essay and the simple fact answer tests under actual classroom conditions was about 60 percent; that about 40 percent of the mental functions measured by the former were not measured by the latter; and 40 percent of the mental functions measured by the latter were not measured by the former. Similar experiments with the "discuss" essay and simple word answer fact tests were conducted by the same authors (359). The results resembled those for the "explain" essay and simple word answer tests.

Weidemann and Newens (388) experimented with the "compare and contrast" essay and true-false tests covering the same material. Each of the seven units of test materials was based upon the content of the course during the two weeks immediately preceding the administration of the given test unit. The consistency of the essay was found to be as high as that of the true-false test. Under classroom conditions the two tests overlapped in mental functions to the extent of from 50 to 70 percent in terms of median values. Approximately 30 to 40 percent of the mental functions measured by the "compare and contrast" essay tests were like 30 to 40 percent of mental functions measured by the true-false tests. The evidence on overlapping of mental functions measured by essay and objective tests is insufficient to warrant any definite conclusion.

The foregoing studies raise the question of what is the nature of the mental functions which such tests measure.

Student Preparation for and Reaction to Testing Programs

Crawford and Raynaldo (364) made twenty comparisons in fourteen different classes. One-half of the students in each class were required to take notes on the lecture while the other half just listened. The next day the groups were reversed. True-false and essay tests were given after each of four such rotations. Those who took notes were inferior as measured by the true-false test but superior as measured by the traditional essay test. The authors suggested that the true-false test emphasizes unorganized use of fact material. However it must be noted that student note-taking does not necessitate organization of material.

From a questionnaire, Douglass and Tallmadge (365) found that students preparing for an essay examination said that they read and reviewed generalities and trends, attempted to draw several important conclusions from tables, formulated personal opinions, and read notes on the text and lectures carefully but without picking out details to be memorized. Students stated that when they prepared for objective tests they learned tables and minute details of materials covered and tried to remember the exact words of the book and other specific points. The procedure of learning was given by about an equal number of students in studying either for the essay or objective test.

Meyer (373), upon examination of studies by Terry (385), Douglass and Tallmadge (365), and Crawford (363), concluded that essay examinations result in a superior type of preparation, more adequate learning, and more recall than the true-false, multiple-choice, or completion types of examination. For the most part, these results are based upon questionnaires.

Meyer (374) divided 124 students into four groups, each studying for three two-hour periods on Civil War history. One group was told to study for a true-false test; a second group studied for a multiple-choice test; a third group studied for a completion test; and a fourth group studied for an essay test. At the end of the study periods all groups were given all four types of test. Five weeks later the same testing procedure was again followed. Meyer concluded that the examination set which the individual has is of fundamental importance in learning and retaining sense material. The essay examination set should be used in preference to any objective examination set if the student is to recall material in an organized fashion and to know facts when cues are not given.

In the field of student opinion Klise (370) found that of 2,065 students at Iowa State College 79 percent preferred the true-false, multiple-choice, and completion combination of objective tests; 18 percent preferred the essay test; and 3 percent were undecided.

Hastings (367), in experimenting with examinations constructed by students in college English, concluded that such procedure leads to student review work, increases cooperation between instructor and student, and results in an examination which is satisfactory to the instructor.

Summary

Research with the essay test has, in the main, been conducted with the traditional or unimproved form and comparisons have been made with improved forms of objective tests. Such comparisons indicate that the improved objective test measures as good as or better than the unimproved essay test. When analysis of essay tests into defined types such as *list*, *outline*, *describe*, *compare*, *contrast*, *explain*, *discuss*, *develop*, *evaluate*, and *summarize* is achieved for instructional use, comparative studies using improved essay types and improved objective types of tests will become possible.

The use of both objective and essay tests seems to be a better basis to evaluate the achievement of such varied results as specific, general, and organized information.

The foregoing studies give a slight suggestion of two developing tendencies:

1. That objective tests are used to measure certain phases of achievement in such subjects as mathematics, physics, and biology; while both objective tests and essay tests are useful in measuring certain phases of achievement in such subjects as history, social sciences, and philosophy.

2. That objective tests are useful on the elementary-school level; while both objective and essay tests are useful on the college level.

CHAPTER V

Achievement Tests in Colleges and Universities

Factors Determining Significant Characteristics of Educational Tests

THE CHARACTERISTICS significant for an achievement test are determined in any particular case by the uses to which the test is to be put and the effects resulting from such uses. Obviously, tests should be so constructed and used as to promote rather than hinder important educational values. Hence, studies of the uses and effects of tests are essential to the sound development of educational testing.

In the college testing field there have been few carefully conducted studies demonstrating potential uses of achievement tests. Investigations of desirable and undesirable effects of tests are still more limited. Most publications on this topic are arguments for or against various uses, or else present very incomplete and inconclusive evidence of values promoted or hindered by educational testing.

Uses of Achievement Tests in Colleges

In the selection and guidance of college students, achievement tests as well as aptitude tests are frequently used. Nevertheless, few studies have been made to evaluate this practice. The Committee on Personnel Methods of the American Council on Education (390), after reviewing studies showing the unreliability of teachers' marks, of Regents' Examinations, and of College Entrance Board Examinations, proposed to develop many forms of comparable tests in the various subject fields on the ground that these tests would prove more effective bases for selection and guidance of students. No evidence for this claim was presented. The Study of the Relation of Secondary and Higher Education in Pennsylvania (425) demonstrated wide variability in the functions tested among students within the same college, among the average scores of the various colleges, and among various prevocational groups within the colleges. This investigation suggested but did not establish the possible effectiveness of achievement tests in educational guidance. The annual reports of the American Council's Committee on Educational Testing (418, 419) gave similar data on variability and also suggested the use of tests in guidance. B. D. Wood (459) and E. P. Wood (460) maintained that the major function of testing is guidance and that this function was best met by cumulative records of continued testing. Crawford (402), however, presented data from his work with Yale students which clearly questioned the effectiveness of present achievement tests in the guidance of students. He also doubted the comparability of most tests.

Wagner and Strabel (456), in studying the predictability of foreign language marks at the University of Buffalo, found that marks in this field could be more exactly predicted than in any other field at that University. The average of the Regents' grades in language gave the highest predictive index, whereas the cooperative French test did not foretell success as well as high-school marks. Reeder (438) found a low relation between placement tests and success. Since the criteria of success were the marks given by college instructors, the poor showing of certain tests in prediction may be a fault of the marks rather than the tests. Palmer (436), on the other hand, found a correlation of .70 between prestudy and post-study scores when using the cooperative physics test. He suggested that such test scores made possible great improvements in guidance. In support of this position, Terry (447) found that the Van Wagenen Reading Test administered at the beginning of a course in educational psychology gave a correlation of .72 with the final course examinations.

With reference to the use of achievement tests in the placement of college students in the foreign languages, Gausewitz (408), Henmon (414), and R. E. Monroe (432) collected evidence indicating the value of this procedure. Brigham (397) reported the new College Entrance Examination Board plan for combining entrance testing with placement testing. He presented data indicating the greatly increased reliability of the College Board Examinations in English. Fletcher (407) presented no data but described the use of examinations in giving college credit for postgraduate work in high school and for out-of-school educational progress. Stalnaker and Richardson (446) defined carefully the criteria demanded of tests used for giving scholarships to college students.

In determining the characteristics of college students, Betts (393) used a test on contemporary affairs which he constructed and administered to graduate students in education at Northwestern University. Ellis (405) used the Iowa High School Academic Contest Test in World History with University of Missouri freshmen to discover their achievement in comparison with high-school students.

Jones (420) found sixty-six colleges using a comprehensive examination for the degree in two or more departments. Eighty-five colleges were using this type of examination in at least one department. From this investigation, he contended that the major function of the comprehensive examination is to test the student's facility in bringing to bear upon an exercise ideas and facts from several subject fields.

The most frequently reported use of achievement tests in colleges is in studying the results of various types of educational experiences, procedures, or materials. Haggerty (409), in the North Central Association's study of standards for higher institutions, used the results of tests as one index of the quality of the college. Cheydleur (401) employed foreign language tests to evaluate the success of an experiment in teaching French to adults. H. T. Tyler (452) determined the effectiveness of a remedial reading course by using the Nelson-Denny and the Iowa reading tests. D. F. Miller (431), and Price and J. A. Miller (437), by the use of tests, determined the effectiveness of certain methods of segregating students in zoology courses at Ohio State University. Meyer (430) appraised remedial procedures in zoology by similar tests. Bowden (396) employed the Allport-Vernon Test of Social Values in judging the effectiveness of a course in social psychology. Sinclair and Tolman (441) employed tests to estimate the relative effects upon open-mindedness of an arts college course and a technical course. Hartmann and Barrick (411) attempted to use the Carnegie General Culture Test to determine the effect of college education upon general cultural information. Welborn (457) tried to use tests to determine the nature of logical learning in college classes.

As a means of measuring teaching efficiency both Barr (391) and Hartmann (412) utilized tests. Both presented evidence of the complexity and difficulty of the task.

The studies during the past three years have extended the uses of achievement tests in college. Formerly, their uses were usually restricted to marking students. More and more they have been used in selecting and guiding students, in predicting college success, in placing students within courses and within sections of the same course, in assigning advanced college credit on the basis of examination, in awarding scholarships, in studying the characteristics of college students, in granting diplomas or honors, in studying the effectiveness of educational procedures, and in evaluating teaching ability. The variety of uses is a chief reason for the barrage of criticism which has been directed against many of the tests constructed during the past ten years. The commonly accepted technics of test construction do not produce tests appropriate for such varied usage.

Values Promoted and Hindered by Testing

The effects of testing are undoubtedly significant and varied. They are probably dependent upon the nature of the test, the procedures employed in giving the test, the use to which the test results are put, and the traditions of the college as well as the attitude of the individual student. If testing is a potential power for educational good or evil, it is most unfortunate that we do not have thorough studies of the effects of testing under varying conditions. Most publications dealing with this topic present points of view rather than data.

Douglass (403, 404) pointed out what he believed to be crucial dangers in the testing movement, namely, the narrowing of educational purposes, materials, and procedures because of the failure of tests to cover the broader outcomes of education. He emphasized, as another danger, the stimulation of students to frantic but not well-directed study. Similarly, Krey (423) believed that testing which did not closely parallel the objectives of instruction was potentially harmful. W. S. Monroe (433) maintained that test makers had now become the real curriculum makers because of the effect of tests in directing the efforts of pupil and teacher.

Counter claims were also advanced. Hanford (410) reported that the comprehensive examinations at Harvard had a beneficial influence on instruction by emphasizing the interrelation of courses. He also maintained that the examinations stimulated students toward definite and desirable goals. Boucher (395) found that the comprehensive examination program at the University of Chicago had forced instructors to formulate their objectives and clarify their purposes. Lowell (429) considered tests to have important potentialities as teaching devices. Kulp (424), using weekly tests with graduate students, found an increase in the amount of learning under these conditions. Keeler (421) maintained that educational measurement when it goes hand and hand with instruction stimulates both teachers and students to better efforts. Theisen (449) stated that the effects of measurement thus far have been to turn educational efforts toward reconstruction of curriculums and procedures rather than to continue the status quo. Barr (391) claimed that continued educational measurement is necessary for the improvement of education and that testing is not in itself harmful. Evils come from poor tests or their unintelligent use.

Lindquist and Anderson (427) attempted to meet the criticism of testing by distinguishing two types of tests, the general achievement test and the diagnostic test. In discussing the general achievement test, they advocated restricting the test to what has been learned. They would include a large proportion of items which test only for understanding at a low level and they oppose measurement of desirable emotionalized attitudes. They believe that the dangers inherent in such narrow testing may be avoided by careful administrative procedures. Richardson and Stalnaker (439) claimed that an achievement test need have no pedagogic value and ought not to measure effective qualities. Wilson (458), on the contrary, recognized the influence of testing and advocated a plan of administration by the teachers themselves of all tests which affect teaching. Woody (461) also admitted the possibility of evil effects from testing but maintained that the danger represented a challenge to improve the testing movement.

This brief summary of conflicting opinions shows clearly the need for thorough investigations of effects of various types of tests under varying conditions. If testing may be a power for both good and evil, we need to know more about the values which may be promoted and hindered by testing and the characteristics of tests which will facilitate rather than hinder desirable learning.

Philosophy of College Testing

The major change in the field of measurement in recent years has been the development of a broad philosophy of evaluation. Previously, the important issue in test construction was the relative merits of the various forms of objective test devices. Should one use a true-false test or a multiple-choice test, a multiple-choice test or a matching test, a completion test or a true-false test? Attention was directed to the type of test device which could easily be used for particular kinds of subjectmatter. At the present time, attention is focused on the kinds of evidence which indicate the attainment of various important outcomes of teaching. College courses are offered in order to facilitate certain desirable changes in students. An achievement test is a means of discovering the degree to which these desired changes in students are taking place. The nature of the test will vary with the nature of the changes sought. Evidence of the recall of information is different from evidence of the use of information. Evidence of enjoyment of literature is different from evidence of the ability to judge literature. As test makers have come to recognize that they are seeking various kinds of evidence, they have come to realize that varied test procedures are necessary for collecting the evidence. Educational purposes or objectives have become increasingly the basis upon which tests are constructed. Hence, a first problem of the test maker is to formulate the teaching purposes.

Formulating the Objectives

Although objectives constitute a curriculum problem, they are also basic in developing examinations. When objectives have been formulated in designing a curriculum, they are frequently neglected by the test maker. Examinations are devised without reference to the purposes of the course or of the college. Boucher (394) pointed out that not only the course content and methods of instruction but also the evaluating instruments composing comprehensive examinations must be determined by the objectives set up for courses.

Johnson (417) stated that the important preliminary step in constructing tests in science courses is to formulate the objectives of the courses. According to Kelley and Krey (422), any examination designed to test learning in the social sciences must consider the objectives of teaching in this field. Uhl (455) emphasized the importance of appraising heretofore neglected outcomes of teaching. The need for getting evidences of changes in character and attitudes as well as changes in intellectual accomplishment was pointed out by Robbins (440).

Teachers often assume that if a student has acquired much of the information in the course, he has also reached other important objectives to an equal degree. Information tests are used as the only measure of achievement. Eurich (406) gave evidence that in the achievement of objectives in freshman English many relationships are very low and none are high. Similar findings were obtained in other fields. Hence, in order to get a clear picture of the growth of students, it is important to get evidence of changes in the direction of each of the important objectives.

In the absence of objectives based on curriculum studies, Tyler (453) suggested two methods useful in formulating the objectives. One method was to consider the general purpose of a course and to analyze it into its subfunctions. The analysis continues to the point where the objectives become clear and useful in teaching and appraisal. A second method was to consider the course content, the teaching and administrative procedures, and with reference to each topic and each procedure ask: Why is this a part of the course? What change in student behavior is this expected to bring about?

Clarifying the Objectives

Usually after objectives for courses have been formulated, little has been done to clarify the objectives in terms of student behavior. Unfortunately, the objectives remain vague and nebulous statements. They do not describe the kind of behavior representing evidences of changes in the direction of the objectives. Hence, in constructing examinations, the objectives have often been passed by. Jumps have been made to a test exercise. Research workers in the testing field have frequently skipped the questions, "Does the kind of behavior required on this test express an important objective of the course? Do the kinds of behavior required in this test give evidence of all the important objectives of the course?" These are the significant problems when establishing the validity of tests.

In the field of literature, Carroll (399) defined prose appreciation as the ability to distinguish between literary selections previously judged to be good or poor. This definition became the basis for his test. The significance of definition is seen by the fact that the test requires of the student, kinds of behavior which are different from other kinds of behavior which are often called appreciation. Noll (435) maintained that when students mark certain carefully chosen statements as true or false or doubtful, the students are exhibiting evidences of scientific thinking, consisting of habits of accuracy, suspended judgment, open-mindedness, intellectual honesty, criticalness, and the habit of looking for true cause and effect relationships. The question arises, Is the kind of behavior involved in identifying true and false statements, evidence of scientific thinking? Turnbull and Griffith (451) reported some objectives of college home economics courses and the kind of behavior describing each of these objectives.

Collecting Test Situations

A third problem in preparing an examination is that of collecting the kinds of situations in which the behavior is expected to take place. This aspect is usually neglected. It has been tacitly assumed that a paper and pencil situation is the kind of situation in which the behavior is expected to take place. If we wish to find out how well a student uses arithmetic in situations which he meets in life, his behavior in those kinds of situations should be noted and recorded. If we wish to find out how skilful a student is in the chemistry laboratory, we should observe his behavior in the laboratory as he works on a variety of problems. The examination would consist of situations which would be representative of the variety of situations in which the student has an opportunity to use arithmetic or to work in the laboratory.

What are the conditions under which the behavior is expected? Are the students expected to remember the information pertinent in answering the questions in an examination or may they have the opportunity to consult sources of information? Stalnaker and Stalnaker (443, 444) pointed out the advantages of and results obtained in an open-book examination. There is need to investigate in similar fashion other important conditions characterizing test situations.

A second aspect of the problem of collecting test situations is that of the size of the sample. As the sample of situations increases in size, the results obtained are more stable. The test is said to be more "reliable." Lindquist and Cook (428) presented evidence showing that the reliability and validity coefficients of certain spelling tests are a function of the time limits in which the tests are administered. The time limits were based upon the percent of students finishing each test. This is a further illustration of the conditions of the test situation. How much time should be allowed for the test? Should the time limit be that necessary for 25 percent of the pupils to finish, or should it be long enough for all pupils to finish? These questions go back to the meaning of the objective. If the test is designed to collect indirect evidence, the optimum time limit is one which gives the best index of the direct evidence.

Recording the Behavior

Two chief uses of a record of the student's behavior are that the behavior may be evaluated at a later time and independently by other individuals. On a paper and pencil examination, the student makes his own record. It is often assumed that this is the only kind of record of changes in the behavior of students. Charters (400) reported the use of the anecdotal record at Rochester Athenaeum and Mechanics Institute. Significant observations of students were recorded. These descriptions of behavior could be evaluated independently by others at a later time. Hence, it is important in recording the behavior to separate the descriptions of the behavior and the evaluations. In an anecdotal record the evidence of behavior is available. In a trait rating device, the evaluation only is recorded.

A record may also be the product resulting from student behavior. Students' themes and art productions are evidence of changes in behavior. A frog dissected by a student is evidence of the student's ability to dissect a frog. R. W. Tyler (453) reported the use of a checklist in recording the behavior of a student in using a microscope and in describing the student's mount. Tharp (448) used a phonograph in recording students' French pronunciations. The records were evaluated at later times by other individuals. Slow motion pictures have been used as diagnostic instruments in recording the behavior of athletes and getting recorded evidence of close decisions. Likewise motion pictures may be used in recording the behavior of a speaker. Photographs may be used as evidences of physical growth.

Evaluating the Behavior

Most standardized tests yield a score for a student *in a subject.* The interpretation of the result is in terms of the relative size of the score in the subject. Recently there has been a shift in interpretation, from achievement in each subject to achievement in each of the important objectives of a subject or in an important objective of several subjects. From this angle the evaluation of a student's achievement can be made in light of the kind of behavior expressing each objective, and not only in terms of a score in a subject.

The essay examination received much criticism due to the variability among readers in grading the same examination paper. In grading essay examinations, it is assumed that readers are evaluating the student's reactions on the same objective. This assumption is not always sound. For example, in grading a test on ability to use information in new situations, some readers forget the objective and grade the test on the amount of information the student has stated instead of the degree to which pertinent information is used in solving a new problem. Wide variations in the scores result.

Trimble (450) studied the objectivity of oral examinations. The students' oral responses were evaluated on eight traits by three judges. The interrelationship between the ratings of the judges on the traits ranged from –.23 to .80.

Another assumption involved in evaluating the behavior on an essay question is that the readers have the same standard of response in mind. This assumption can be checked in a meeting of the readers at which time the ideas which are expected in the responses are brought together and the numerical values allotted to each idea may be decided upon. Each reader may be given a copy of these specifications to follow in grading the essay questions. Stalnaker and Stalnaker (445) reported that when readers "analyze the ideal answer," and assign "a certain number of points to each significant part of it," the readers agree more closely. Agreement in evaluating English examinations at the University of Chicago increased from .42 to .92. Horney (415) found close agreement in scoring a test of understanding chemical principles when the responses were evaluated with a definite type of behavior as the standard.

A prevalent misconception of an objective test was clearly discussed by Brownell (398). The misconception assumes that an objective test lacks subjectivity and hence is more satisfactory than an essay test. Brownell points out many instances where subjectivity and judgment enter into the construction, administration, and use of objective tests. Objective tests are objective in that competent individuals agree in the scoring. Objectivity is an important characteristic of evidence. However, it should not be purchased at the expense of the primary characteristic, validity. This leads us to another major problem in preparing examinations.

Practicability of Examinations

The ease with which evidence of the achievement of an objective of teaching can be collected and evaluated is an important consideration in an evaluation program. A test which is easily administered and quickly scored is more likely to be used than one in which the evidence is difficult to collect and time-consuming to score. There is much evidence to show that important outcomes of teaching are not evaluated because practicable methods are not available for collecting evidence of progress.

Practicability is so much desired that teachers have eagerly accepted, easily administered, and easily scored paper and pencil examinations and have assumed that they were valid. They have not asked about each test, Does it require of students the kinds of behavior which represent the objectives of my course, or does it give a satisfactory index of this behavior?

Index devices make an evaluation program more practicable. Although they do not yield direct evidence of desired behavior, they are valuable when they give a satisfactory index of the direct evidence. In college chemistry courses, an important objective is the ability to apply chemical principles. Hendricks, R. W. Tyler, and Frutchey (413) reported research in checking an index device with direct evidence of this outcome. An objective of French instruction is the ability to pronounce French words. Direct evidence of this ability may be collected about each student as he reads and pronounces French words. It is a time-consuming job to obtain this kind of evidence for each student and have it evaluated by two or more trained judges. Tharp (448) experimented with a paper and pencil index device which can be administered in class in five minutes and scored in less time. He made phonographic recordings of students' French pronunciations and had the records played and the pronunciations judged by three French teachers. The students also took the index examination. The correlation between the average ratings of the three French teachers and scores on the index examination was .84. If this relationship continues to hold from time to time with other groups of students and teachers, a practicable device is available for collecting evidence of the ability to pronounce French. As W. S. Monroe (434) pointed out it is misleading to assume that the relationship between direct and indirect tests is fixed. The assumption should be checked frequently.

Item Validity

Several methods of item validation have been used in selecting items for a test. Kelley and Krey (422) proposed that a good item for inclusion in a test is one whose "difficulty" decreases as the school grade increases.

Kelley pointed out that "items selected in this manner can be built into a final test which does consistently measure something, but whether it is what the test label calls for remains a matter of judgment."

Another method used in item validation is the degree to which an item discriminates between the better and poorer students. Differences have arisen in choosing an appropriate criterion for selecting the better and poorer students. In some cases it is assumed that the total score on the general achievement scale is the valid criterion. According to Lindquist and Anderson (427), "an item may be said to be perfect in discriminating power when every pupil who responds correctly to the item ranks higher on the general achievement scale than any pupil who fails on the item."

This method of statistical validation of test items has been used to pick out and eliminate from a group of test items those of low "validity" so that the test consisting of the remaining items will have higher "validity." Smith (442) proposed to test this hypothesis and concluded from his evidence that "so far as obtaining more and more valid instruments of measurement is concerned, statistical evaluation of individual items apparently has little to contribute."

The purpose of these methods of statistical validation is to construct a test which is consistent with respect to an internal criterion. When the criterion is the total score on the test, it is assumed that the test itself is valid. The question then arises, What makes the test itself valid? It appears that the answer to that question goes back to the meaning of the objective—the behavior expressing the objective, the situations in which the behavior may occur, and the evaluation of the behavior. The essential characteristic of validity is the kind of evidence which expresses the purpose of the evaluation.

Statistical methods are useful in making a test internally consistent or homogeneous. The process selects items which are highly related to a whole group. The kinds of items selected by the procedure are probably those kinds which are greatest in number in the total test and which have been given the most weight in the scoring. For example, in a test on educational statistics, including many items on computation and a few on interpretation, statistical validation of the items would discard the items on interpretation and tend to make the test internally consistent in respect to computation. Some of the computation items may be discarded also. Statistical validation in this sense destroys the value of the test for the purposes for which it was constructed. The process eliminated opportunities to get evidence of the ability of the students to interpret the use of statistical measures and some important kinds of behavior in computation.

Statistical methods are also used in selecting items by checking each item with an outside criterion. Horst (416) reported their use in developing a test for selecting salesmen. The external criterion was success on the job. The purpose was to build a test which ranked the employees in the same order as did the measure of success of one's work on the job.

From an original group of tests given the employees, items were selected which correlated highly with their success on the job and correlated but slightly with each other. In this way a new test was built which had a very high predictive value of success of the job. The validity of the new test rests upon the degree to which it is a good *index* of the valid kind of behavior—that which was used as evidence of success on the job.

Research Considerations

Lehman and Witty (426) gave seven major objectives of an introductory course in psychology and pointed out seven obstacles involved in formulating objectives. These difficulties are founded on certain assumptions which often are not necessary to make. For example, a difficulty is "the disparity among the objectives that have been published." The assumption underlying this obstacle is that *all* introductory courses in psychology should have the same objectives. Fortunately, it is not necessary to make this assumption in setting up objectives. Teachers or departments may formulate the purposes for their own courses. Another difficulty, "our limited knowledge of the psychology of learning," is based on the assumption that we must know how learning takes place before we can find evidences that it has taken place. This assumption also is not necessary. If we can detect evidences of changes, it is not necessary to know how the changes have occurred, for the purposes of formulating objectives. Research in improving examinations must consider the assumptions underlying an appraisal program.

The development of testing technics likewise involves a series of assumptions. R. W. Tyler (453) pointed out some of these assumptions and suggested procedures for checking them. "If an appraisal program is to develop a sound body of philosophy, techniques, data, inferences, and principles, it is essential that these assumptions be tested one by one, so that we may be able to separate findings and methods which are based upon valid assumptions from those which are untenable because the assumptions underlying them are not true. This is a task which challenges all who work in the field of achievement test construction."

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